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This work is being done by Gibbons Bros., Reed and Roche, Contractors, and is under the direction of Sylvester Q. Cannon, City Engineer of Salt Lake City.

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Engineering News

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Chicago's Bubbly Creek Will Bubble No More

The notorious Bubbly Creek, which has had such an unsavory history in relation to the sewerage system of Chicago, will soon be a thing of the past. A conduit is being constructed to carry the sewage and industrial wastes that were discharged into it, and the creek is being gradually filled with city refuse and earth.

This creek is the west arm of the end of the south fork of the south branch of the Chicago River, as shown on the map, Fig 2. The east arm is known locally as the Stockyards Slip. The west arm was originally a small creek, almost dry for months at a time.

Many years ago a channel or dock was excavated as an extension of this arm, about ⅛ mi. south of 39th St. and running westward half a mile from Ashland Ave. This street was carried over the channel by a swing-bridge, which was used only for passing dredges and pile-driver scows, navigation having been abandoned years ago. The channel was about 150 ft. wide. The clay excavated was used in making brick, and near the west end there is still an old deep clay pit that necessitates special construction in carrying a new sewer across it.

Into this dead-end channel have poured the filth, refuse and wastes from half the packing-house and stockyards district, as well as from a main sewer afterward opened into it at Robey St. The sluggish flow from the creek was northward in the fork, many days being consumed in reaching the junction with the south branch of the river. In the dredged channel the water was practically stagnant, and this became in effect a huge open septic tank long before Cameron applied the name to a tank for sewage disposal purposes.

In 1910 the Western Ave. conduit was built, connecting the western end of the creek with the main drainage canal at Western Ave. This conduit is of concrete and passes under the old Illinois & Michigan canal by means of a siphon. The exceptional character and stale condition of the sewage in this conduit have been the cause of some disintegration of the concrete. This trouble was discussed in *Engineering News*, Sept. 14, 1916. The velocity in this conduit was low, and the flow was so small in proportion to the capacity of the creek that the latter continued to be practically an immense septic tank, its condition giving rise to its significant name.

FIG. 1. THE WESTERN END OF BUBBLY CREEK, CHICAGO

The water (or sewage) here is about 18 ft. deep, but is almost entirely covered with a floating mass of débris and rubbish. The north bank (at the left) is a city dump and the creek is gradually being filled

At present Bubbly Creek is about 150 ft. wide, with 5 to 20 ft. of water. At times it is so covered with a heavy mass of septic-tank scum in some places and with

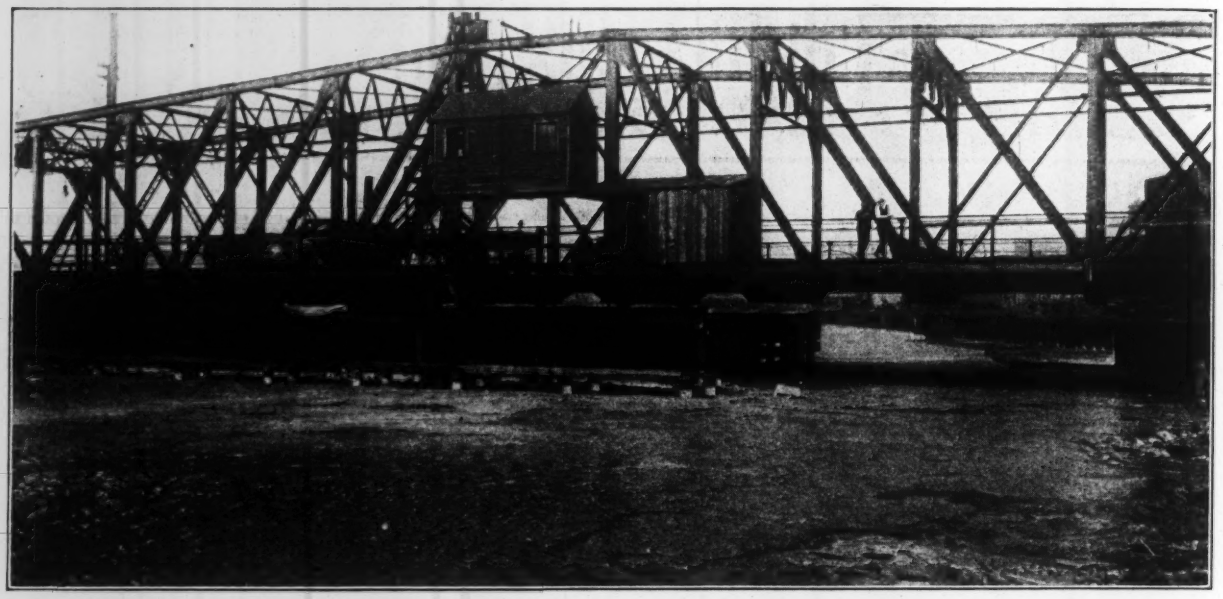


FIG. 3. BUBBLY CREEK; CHICAGO'S OPEN SEPTIC TANK (NOW BEING ABOLISHED)

This view is at the eastern end, at Ashland Ave. The water is almost entirely covered with a thick mass of septic-tank scum. Just beyond the bridge a bulkhead has now been built to close the channel

refuse and rubbish in other places that it has the appearance of a shallow and dried-up swamp. There is a legend that a drunken man who fell off the Ashland Ave. bridge walked ashore dry-shod on the covering of scum. However that may be, chickens and dogs have been seen to walk across.

The scum-covered condition of the creek at its eastern end, at the Ashland Ave. bridge, is shown in Fig. 3. At the right, just beyond the bridge abutment, is the temporary outlet of the Ashland Ave. sewer, with a raft from which men scoop up the floating grease. Fig. 1 is a view near the western end (looking east), showing the city dump on the opposite (north) bank. The water here is about 12 to 18 ft. deep, but is entirely covered with most offensive floating débris and refuse.

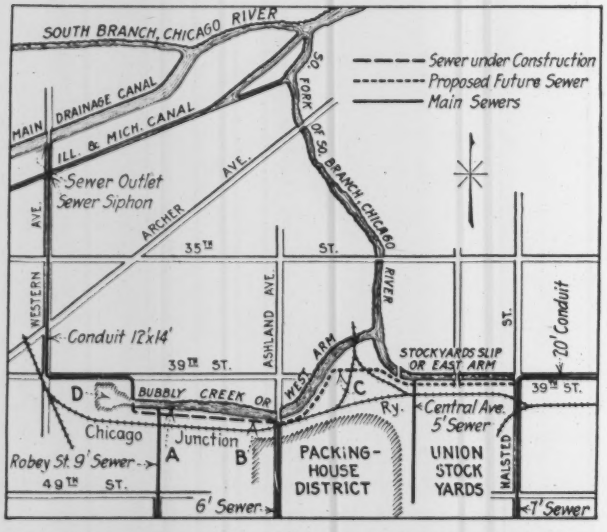


FIG. 2. MAP SHOWING RELATION OF BUBBLY CREEK TO THE SEWERAGE SYSTEM OF CHICAGO

A—Portion of Bubbly Creek now being filled. B—New sewer under construction. C—Possible future sewer for Stockyards Slip. D—Old clay pit crossed by new sewer

It is hardly credible that the city should have permitted such an unsanitary and disgusting place to exist for so long. Doubtless one reason is that it is in the territory adjacent to the stockyards and packing houses, the residents of that territory not being apt to make any powerful protest against disagreeable or dangerous conditions.

Now that this "septic tank" discharges into the main drainage canal it comes under the jurisdiction of the Sanitary District of Chicago, the authorities of which have made strong protest against allowing the liquid and semi-solid wastes to be disposed of in this way. The protest is due not only to the unsanitary conditions, but to the very large amount of water necessary for the dilution of the material to the extent called for by the law in relation to the drainage channel. Much experimental work has been done, both by the packers and the Sanitary District, and in August, 1916, after protracted conferences, a committee representing both interests was appointed to endeavor to work out a practical solution of the problem of treatment of the wastes. This committee is composed of W. D. Richardson, chief chemist of Swift & Co., and Langdon Pearse, division engineer of the Sanitary District of Chicago. This action is the result of a growing public opinion and a determined movement on the part of the trustees of the Sanitary District to require the packing houses to screen and treat the wastes before discharging them into the channel. The activated-sludge process appears to offer a solution of the problem, as noted in *Engineering News*, Aug. 31.

In order to avoid the septic-tank conditions resulting from sluggish flow in the present channel, and to allow the west arm to be filled up, a sewer is being built along the south bank of Bubbly Creek, as shown in Fig. 2. This will intercept the Ashland Ave. and Robey St. sewers and will connect with the Western Ave. outfall conduit mentioned above, giving a normal velocity of flow to the drainage canal. Thus Bubbly Creek will be eliminated from the sewerage system. The north bank

is now a city dump, so that the channel is gradually being filled. The east end of the channel has been closed with a timber bulkhead, cutting off its connection with the south fork of the river; and when the fill at this end is completed, the Ashland Ave. bridge will be removed.

The history of Bubbly Creek from its sewerage aspect would not be complete without reference to the use of its foul and sluggish companion—the east arm, known as the Stockyards Slip—as a source of water-supply. A few years ago the stockyards interests, finding the supply from the city's mains inadequate and expensive, decided to utilize the slip for a private supply.

A mechanical filter was installed, and in addition hypochlorite of lime in large amounts was used to disinfect the water—a pioneer chlorination plant. Although the effluent was claimed to be pure, the City of Chicago prohibited its use for drinking purposes or for watering animals. The installation was then converted into a water-softening plant for the use of the Chicago Junction Ry. and is now operated largely to provide water for flushing the cattle pens.

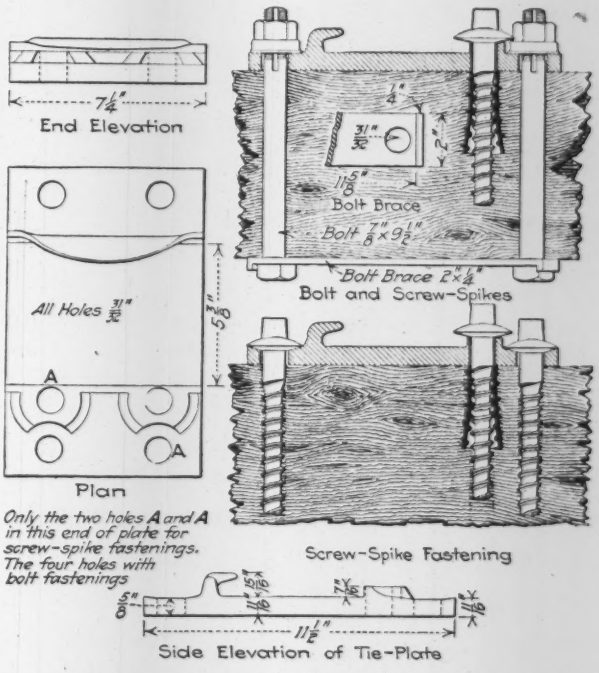
The raw water was very heavily polluted with sewage, as the slip received the discharge of the flushing tunnel from the 39th St. sewage pumping station, this discharge varying from straight domestic sewage to a sewage diluted with 10 to 15 parts of lake water. The slip also received a large amount of stockyards refuse and waste. Probably no other filter plant in the world has ever handled such a strongly polluted water. The large amount of hypochlorite used necessarily left a decided taste and odor in the water, which stock shippers claimed was distasteful to cattle.

A plan is under discussion to fill in the Stockyards Slip and to build a sewer connecting with the present Halsted St. outfall and leading to the sewer now under construction along Bubbly Creek. This would give a continuous closed channel from the intercepting-sewer system to the main drainage canal. It is doubtful if the slip will be filled up for a good many years to come, but the sewer beside it may be built first as a means of collecting the sewage for treatment of the industrial wastes.

Experimental Rail Fastenings

The use of hooked tie-plates with screw-spike and through-bolt fastenings is being tried on the Delaware, Lackawanna & Western R.R. as a development in track for heavy traffic. The two types of construction are laid on certain test pieces of track, and are shown in the accompanying drawing.

The tie-plate has a shoulder on each side of the rail seat, and one of these shoulders is formed as a hook or lip to engage the edge of the rail base. The plate is laid with this hook on the inner or gage side of the rail. With spike fastenings, each plate is held to the tie by screw spikes, and the rail is held by one drive spike 5/8x6 in. on the outer side. With bolt fastenings, each plate is secured to the tie by two 7/8-in. through bolts (at diagonally opposite corners), the heads being beneath the tie and prevented from turning by means of a channel-shaped washer or brace which engages both bolts. The rail is held on the inner side by the hook of the tie-plate and on the outer side by the head of a screw spike. This screw spike is held in the tie by means of a Tenax split sleeve. Bolt fastenings for rails and rail-chairs have been used for many years in Europe, and this present design of through-bolt fastenings for tie-plates has been developed by A. J. Neafie, Principal Assistant Engineer of the railway, who has great hopes for its use in permanent construction. He believes that as railways are now using treated ties and expensive tie-plates under heavy traffic, especially on curves, they can well afford to go into the question of bolted fastenings. This should be an ideal construction also for subways and tunnels, where it is difficult to apply new material in maintenance work. The modern construction consists of treated materials, heavy tie-plates, screw spikes, etc., which material should have a minimum life of at least 14 years, according to Mr.



EXPERIMENTAL TRACK WITH HOOKED TIE-PLATES AND BOLT AND SCREW-SPIKE FASTENINGS

Neafie's estimate. He considers therefore that the question of applying bolts is not a serious one, and they need be applied only in new work and renewals.

One serious condition in track is that of corrosion of rails and metal fastenings, and prior to the design of this bolted construction the engineering department had gone into the matter carefully, spraying the fittings with oil once or more per year if necessary, in order to prevent any trouble from corrosion. On the test location of the new fastenings, all bolts have been greased and the bolt holes filled with grease. The bolts are fitted with special nutlocks, each of which represents a compression of 2,000 lb., making a total compression of 8,000 lb. on the tie-plate, and thereby reducing the mechanical wear that takes place when tie-plates are loose on the ties. It is believed that fastenings of this type will be adopted on heavy permanent track construction.

The hook-shoulder tie-plate applied with screw-spike rail fastenings has not developed any great amount of noise due to contact between the rail and hook. The tie-plates fit the rail base very tightly, but there is no wedging of the rail under the hook. Even where there is a loose fit between the tie-plate and base of rail there is no apparent rattling or noise.

Device To Prevent Blowouts in Shield Tunneling

By Frank D. Leffingwell*

All subaqueous tunnels thus far built in porous ground have been subject to extraordinary hazard, expense and delay. This has been due to excessive escape of compressed air and disastrous blowouts, which continue to occur in spite of the best attempts at control.

The sole reliance of the builder has thus far been the clay blanket—a device costly, uncertain and highly unsatisfactory. The blanket has features that are clearly unsafe and the method of deposit invites its ultimate destruction through forces which it aims to control.

In the light of modern knowledge, however, it is feasible to modify the ordinary blanket and develop a construction that will insure safety.

How Blowouts Occur

The sketch, Fig. 1, represents a tunnel being excavated in porous ground, but at such depth that the excess head of escaping air is largely balanced by the friction encountered. It is evident that if either depth of cover or its unit resistance be lessened a clay blanket must be added.

Fig. 2 shows a case in which the porous cover is not adequate to limit the air escape. A clay blanket, theoretically solid and homogeneous, has been placed on the river bed. The weight and tenacity of the blanket oppose vertical loss of air; the width of the blanket controls lateral escape.

The real clay blanket, as against the theoretically solid one, is of the kind sketched in Fig. 3. Deposited in separate scow loads, the clay never becomes a solid mass. The air leaking up from the tunnel face tends to seep along the joint surfaces of the clay. The result is a common experience: Sooner or later the blanket is punctured at some point of incipient flow, torn open and tossed aside (Fig. 4).

An attempt was made in April, 1905, to cure the weakness of the clay blanket in a radical way. This was on the Brooklyn side of the Battery tunnel under the East River, at the foot of Joralemon St. Walton I. Aims, Chief Engineer of the New York Tunnel Co., planned to seal the porous ground by first spreading sailcloth and then placing the blanket (Fig 5). This was a success in so far as vertical escape of air was prevented, but it failed to control lateral or longitudinal flow of the air along the smooth under surface of the canvas. When, to control this lateral escape, weight was added to the blanket, more "blow" continued at the lateral edges, and a hole formed under the canvas cover until finally, under the influence of the weight from above and agitation from below, the canvas sagged and was caught by the hood of the shield in passing.

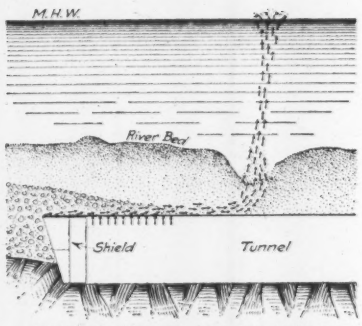


FIG. 6. BLOW ON BATTERY TUNNEL

Further illustration of how direct a relation horizontal flow of air bears to this question was furnished later in the same year (1905) on the Battery tunnels. An incipient blow occurred about 200 ft. back of the heading, as sketched in Fig. 6. While it did not get beyond the point of being a rather lively local leakage, it pointed to the possible cumulative effect of leakage from the tunnel in combination with longitudinal flow of the air along a smooth horizontal surface, and its tendency to cause trouble. Evidently any method of preventing upward blowouts will be a disappointment if it does not also control the tendency to lateral flow. The method of Fig. 7 has been developed by the writer as a full solution of the problem. It consists of the use, with a blanket, of a river-bottom diaphragm or seal provided with baffles on its lower surface to prevent flow of air along its under side. This river-bottom diaphragm, which the writer is patenting, contains the elements necessary for dealing with all the separate factors promoting blowouts. Its use promises to afford economy in amount of blanketing material, and—the important thing—by eliminating the risk of blowouts take away the one feature of greatest hazard in subaqueous tunneling.

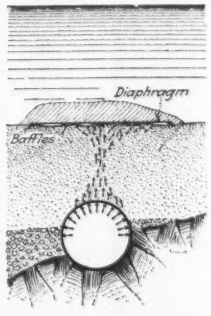


FIG. 7. LEFFINGWELL METHOD

*460 Bloomfield Ave., Montclair, N. J.; formerly Resident Engineer, Rapid Transit Subway Construction Co., Battery Tunnels under East River, New York.

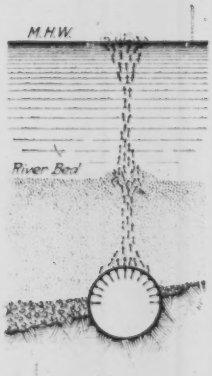


Fig. 1—Air flow controlled by friction

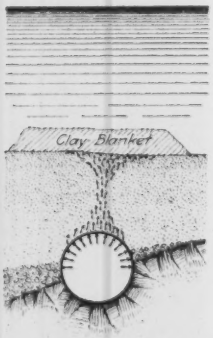


Fig. 2—Flow checked by perfect clay blanket

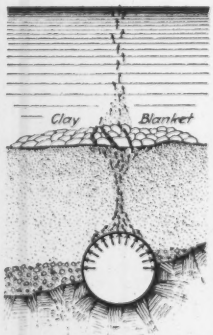


Fig. 3 — Effect of seams in clay blanket

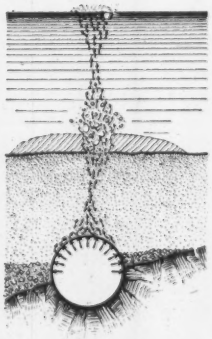


Fig. 4—Blowout through blanket after seepage as in Fig. 3

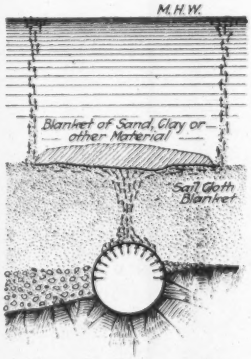


Fig. 5—Flow under Aims' canvas diaphragm

FIGS. 1 TO 5. TYPICAL CASES OF TUNNEL BLOWS AND METHODS OF CONTROL

Tearing Down an Old Concrete Ice Factory

By Arthur G. Hoadley*

SYNOPSIS—Details of methods employed in wrecking a one-story reinforced-concrete building, part of which was used in the layout of a new building.

A baking plant for the Great Atlantic and Pacific Tea Co. has been built during the last year at First and Warren St., Jersey City, N. J., on the site of a one-story reinforced-concrete ice-manufacturing plant. The partial wrecking and removal of this one-story building and the incorporation of certain portions of the old into the new structure furnished several interesting additions to the methods previously used in wrecking a reinforced-concrete building.

The plans showing the detailed construction of the existing one-story building were found after a very diligent search, the building department having destroyed

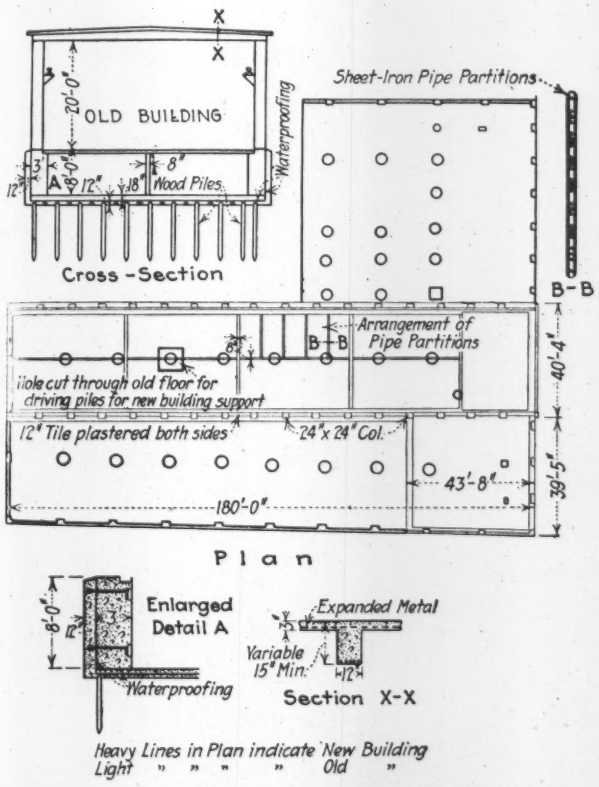


FIG. 1. PLAN AND DETAILS OF OLD REINFORCED-CONCRETE BUILDING TORN DOWN

its copy. There was not enough information shown on the plans, however, to be of much assistance to the designing engineer in incorporating any of the old work into the new building, without first subjecting the old structure to tests that would prove the carrying capacity of the piles and show the reinforcement used in the walls, floors, footings, etc.

The building to be wrecked (Fig. 1) was approximately 180x40 ft. with an east wing 40x40 ft. A mat which proved to have a varying thickness had been poured on top of the pile heads and heavily waterproofed with a membrane waterproofing. From this level the exterior foundation walls and interior cross-walls had been constructed. These cross-walls were 8 in. thick, reinforced

FIG. 2. METHOD OF CUTTING OUT REINFORCEMENT IN WALLS

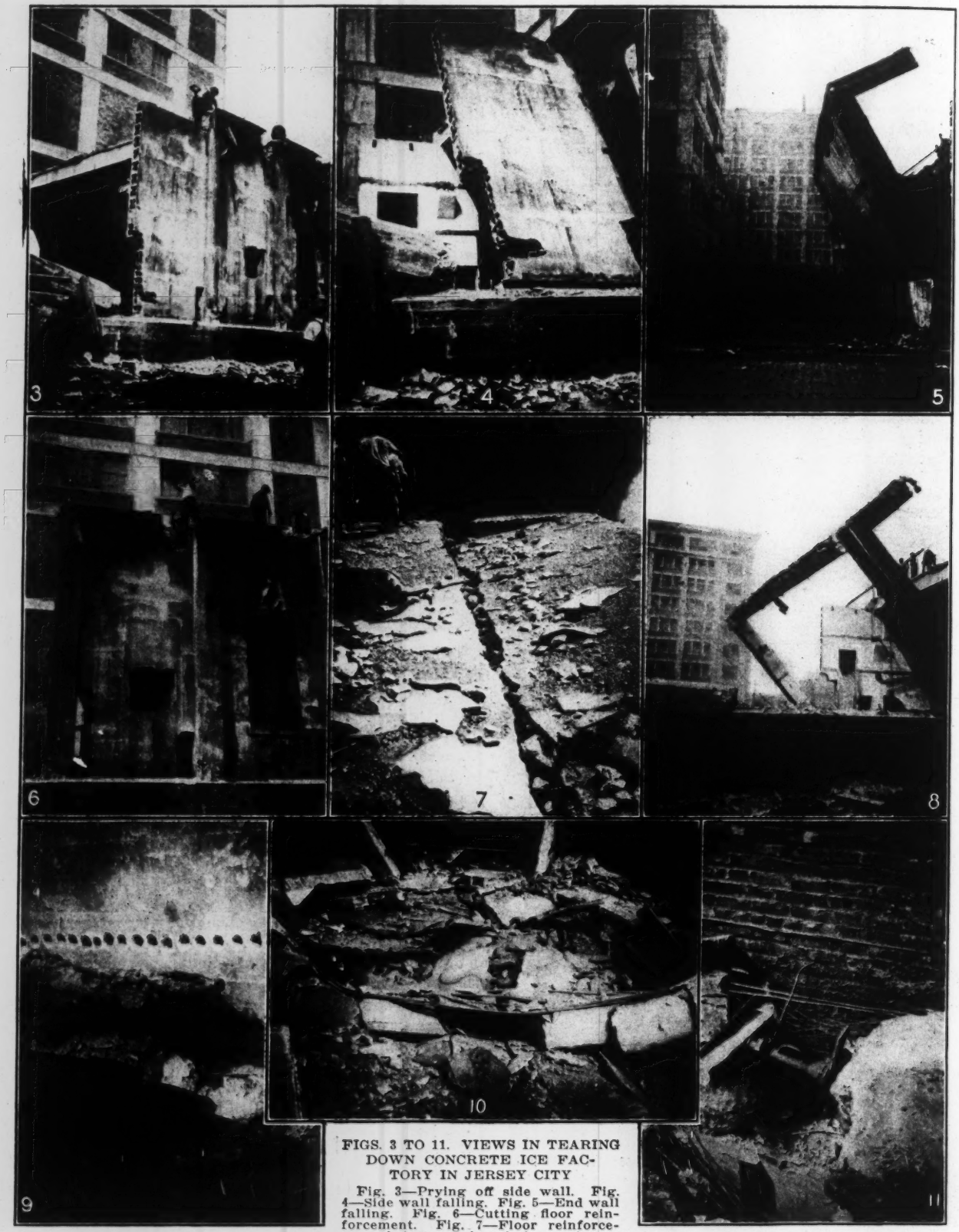
on both faces with vertical ½-in. round bars 4 in. c. to c.; ¼-in. round bars 12 in. c. to c. were placed horizontally.

The exterior foundation walls were not reinforced except at the column points, but heavy reinforcement was placed in an additional 12-in. wall poured on the outside of the main wall to act as a protection for additional waterproofing that it was found necessary to apply. The wall columns were 24 in. square and were reinforced with four 1-in. round bars with ¼-in. hoops 12 in. c. to c. The roof slab was reinforced with expanded metal; the roof beams by a unit system of reinforcement employing four double-bent bars.

All of the superstructure, including the refrigerating equipment, had to be removed, certain walls partly removed to permit new footings and a new building, as shown in Fig. 1, built.

The removal of the refrigerating equipment was accomplished within a month; in the majority of cases the salvage contractor used the oxygen flame for cutting through the pipe partitions which made up the individual freezing tanks. These partitions were constructed of ⅛-in. sheet iron, incasing double extra-heavy wrought-iron pipe. Through one series of these pipes the brine was circulated, while through another series was run the hot water used in freeing the ice from the side of the pipe partition. The manufacturing process was to fill the individual freezing tanks with fresh water, freeze, release by using the hot water, lift with an overhead crane and convey to one end of the building where a tilting table received the large cake of ice in a vertical position, and then revolving itself into a horizontal position fed the

*Superintendent, Turner Construction Co., 11 Broadway, New York City.



FIGS. 3 TO 11. VIEWS IN TEARING DOWN CONCRETE ICE FACTORY IN JERSEY CITY

Fig. 3—Prying off side wall. Fig. 4—Side wall falling. Fig. 5—End wall falling. Fig. 6—Cutting floor reinforcement. Fig. 7—Floor reinforcement being cut just before columns and floor are let go as shown in Fig. 8. Fig. 8—One of the floor sections falling. Fig. 9—Drill holes in foundation wall and break caused by shooting. Fig. 10—Effect of fall on roof beam. Fig. 11—Jack used in pushing down column

large cake to a series of saws which cut it up into the commercial size.

The wrecking of the structure proper was started in the basement with the cross-walls. These walls were 8 in. thick and about 9 ft. high, and reinforced as previously described. There was sufficient room between two of the cross-walls to swing a 16-ft. piece of 3-in. shafting supported at the roof, and to use it as a battering ram. This method worked very efficiently from the top of the wall down to within 2 ft. of the bottom where the reinforcement was near its floor anchorage. For the rest of the wall it was necessary to strip the steel from both faces before using the ram.

In wrecking the central basement wall, it was necessary to strip all steel from the wall and then use a short ram; there was not sufficient room in which to swing the long ram, and a shorter ram did not prove effective. In stripping the steel from these walls two men worked with bull point and sledge. The point was driven down in back of each bar and as it progressed the bar was bent out in a spiral form, thus being entirely out of the way of the workmen, but at the same time destroying the bar for any other use (Fig. 2). In trying out the short ram before stripping the steel from this central wall there was no sign of fill lines, with the exception of one indicating the addition of 6 in. of unreinforced wall on top of the main reinforced section. After stripping the steel, however, there were several fill lines that were clearly defined, indicating the flow line of the concrete and showing the presence of laitance between each fill. No attempt had been made to mix the two fills, which were probably poured on the same day.

It was decided that in wrecking the superstructure a fall of 30 ft. into the basement would be of great help in breaking the concrete into pieces small enough for loading into trucks. This proved true as the photographs show. The wall beams were first cut through to provide room for inserting a screw jack. The four vertical column bars were exposed and cut at the bottom; then the roof slab was cut on three sides leaving the expanded metal intact until everything was in readiness for dropping the slab. The expanded metal was cut on the two ends of the slab and then adjacent to the roof beam. An interesting fact regarding this operation was the cantilever action that developed in the strands of the expanded metal; these held the entire slab in a horizontal position until the last strand had been cut. The slab usually fell with sufficient force to tear away from the opposite beam, but in some cases the fall was gradual, and the reinforcement although bent at right angles held the slab in a hanging position. Fig. 7 shows the slab just as it has started to fall; the large man in the picture has just cut the last strand of the expanded metal.

The next operation was to push over two columns, together with their respective wall beams and their connecting roof beam. This was accomplished as in Fig. 11, which shows the jack in position ready for forcing the section past its center of gravity. Two jacks were used, one in each wall beam, and were worked simultaneously. Fig. 8 shows one of the sections in the act of falling.

The exterior walls were 8-in. hollow tile plastered both sides, but not anchored in any way to the columns; not even a wall recess was provided in the columns. This made it particularly easy to force these walls into the basement after the section of superstructure immediately in front of them had been disposed of. Fig. 3 shows the wall being started with a 2x4-in. pry. Fig. 4, the same wall in the act of falling. Needless to say these walls were entirely demolished in falling into the basement. Fig. 5 shows the end section of the wing falling intact. The last section to be dropped was the north end of the main building and the wing combined; these were pulled over by lines placed on the ends and in the center and operated by six men on each line. Fig. 10 shows the effect of the fall on one of the main roof beams.

There were two areas cut in the south section of the old building basement wall and through these openings it was possible to drive the teams into the basement and load the débris, which amounted to 608 two-yard loads for the entire job. The columns usually fell on top of the foundation walls and so were not broken in falling. Two of the entire lot were shot with powder, but it was found to be cheaper to release the steel at each corner and then break up with a heavy sledge hammer. The steel from the columns was used in the new footings as was also any of the beam steel that could be salvaged.

The holes cut in the basement floor for driving additional piles were blasted, but under very unfavorable circumstances because of the varying thickness of the floor slab. It was impossible to drill to a uniform depth for shooting. A fabric waterproofing was incorporated in this floor, as well as a very great number of reinforcing bars, which made it very difficult to remove the concrete after it had been shattered by the blast. The blast did not break the steel in the great majority of cases.

The east exterior wall was used as a bearing wall for supporting the first floor and was cut off and recessed for the beams and girders. The north wall was used as a bearing wall also, but additional piles were driven on each side and a new footing poured on top of the old and new piles, thus in reality underpinning the old wall. Much difficulty was experienced in drilling this old wall on account of the heavy layer of waterproofing that clogged the drills. The main wall in this case was not reinforced, but the 12-in. waterproofing protection was heavily reinforced with square bars. Fig. 9 shows the arrangement of blasting holes and the effect of the first shot.

The unusually thick foundation walls in the main portion of the old building were in no way damaged by the vibration due to blasting off the top or shooting the opening for the underpinning. The wing walls, which were but 24 in. thick, were found to be in excellent condition before any additional piles had been driven in this section, but the vibration of the pile-driving together with the blasting so shattered these walls as to make it necessary entirely to demolish the two exterior sections and replace with a new wall. No reinforcement of any kind was found in the wing walls.

The new building was erected mostly during the more severe months of the winter season, but with the aid of heavy canvas curtains and coke fires the speed schedule starting from the completion of the first floor was maintained.

The wrecking of this ice plant and the construction of the new four-story bakery for the Great Atlantic and Pacific Tea Co. were both handled by the Turner Construction Co., of New York City. Ballinger & Perrot, of Philadelphia, were the architects for the new bakery.

Cleveland Water-Supply To Be Purified and Softened

SYNOPSIS—Bacteria and turbidity will be removed and incidentally a not very hard water softened by lime treatment, coagulation with sulphate of iron, and mechanical filtration.

A water-purification plant with a daily capacity of 150,000,000 gal. is nearing completion by the City of Cleveland. The primary object of the plant is bacterial reduction and the removal of turbidity when necessary. At the same time the water will be softened. The plant is located at the Division Ave. pumping station, which is being rebuilt and provided with low-lift pumps to supply the filters and with high-lift pumps to deliver the filtered water to the city. The purification plant and accessories include a coagulant house, mixing chambers, coagulating basins, mechanical filters and a clear-water basin. Some clear-water storage is provided under the filters in addition to that afforded by the clear-water basin. A general view of the plant is shown by Fig. 1, and Fig. 2 gives a plan of the coagulant mixing chambers, coagulating basin and filters and some sections of the chambers.

The plant is notable because it will soften a relatively soft water (total hardness of 110 and temporary hardness of 90 to 55); because with a chemical-handling system otherwise similar to that used at St. Louis the chemicals will be handled only once, instead of twice; and also because of the provision for a thorough mixing of the lime with the water to be softened. The latter will permit a relatively short reaction period of 3½ hr. in the mixing chambers.

The engineers in immediate charge of the design and construction of the plant have been R. Winthrop Pratt, consulting engineer; Frank H. Stephenson, engineer, and Milton F. Stein, assistant engineer of design; and R. S. Jones, engineer, and A. V. Ruggles, assistant engineer of construction. Charles F. Schulz was commissioner of water during the greater part of the construction period and was succeeded by Charles P. Jaeger.

A switch from the Erie R.R. comes up to one side of the coagulant house. At each end of this house the chemicals may be dumped from covered gondola cars onto a short run of conveyor that discharges onto an elevator leading to a hopper, or they may be unloaded from box-cars by power shovels. In either case the chemicals are deposited in hoppers. For the present, box-cars will be used. The chemical agents are taken from the hoppers, crushed if necessary, elevated and distributed to 10 storage bins (Fig. 3), of which eight are for lime and two for sulphate of iron. These storage bins are approximately 16 ft. square inside and 33 ft. high, including the depth of the hopper bottom. The bins are arranged to discharge into a smaller, or daily, hopper. One such hopper is provided for each four lime bins, and there are two others, of metal, for the sulphate of iron.

From the daily hoppers the lime and iron are fed to automatic scales similar to those in use at Columbus, Ohio, except that the scales are so connected to a venturi meter as to trip the discharge of the chemicals at the proper intervals to maintain the required proportions, depending upon the volume of water flow. These scales are supplied by the Richardson Scale Co., of Passaic, N. J.

The lime goes from the scales to slaking tanks (Fig. 5), where hot water is introduced, the lime slaked, passed over a weir and dropped through a perforated hopper into a solution tank. A new feature of the solution tank is the use of a Pelton wheel to drive the stirring apparatus and centrifugal pumps that will raise the lime solution for discharge into the raw water. The water that drives the Pelton wheel goes to the solution tank, so it is not wasted but does double service.

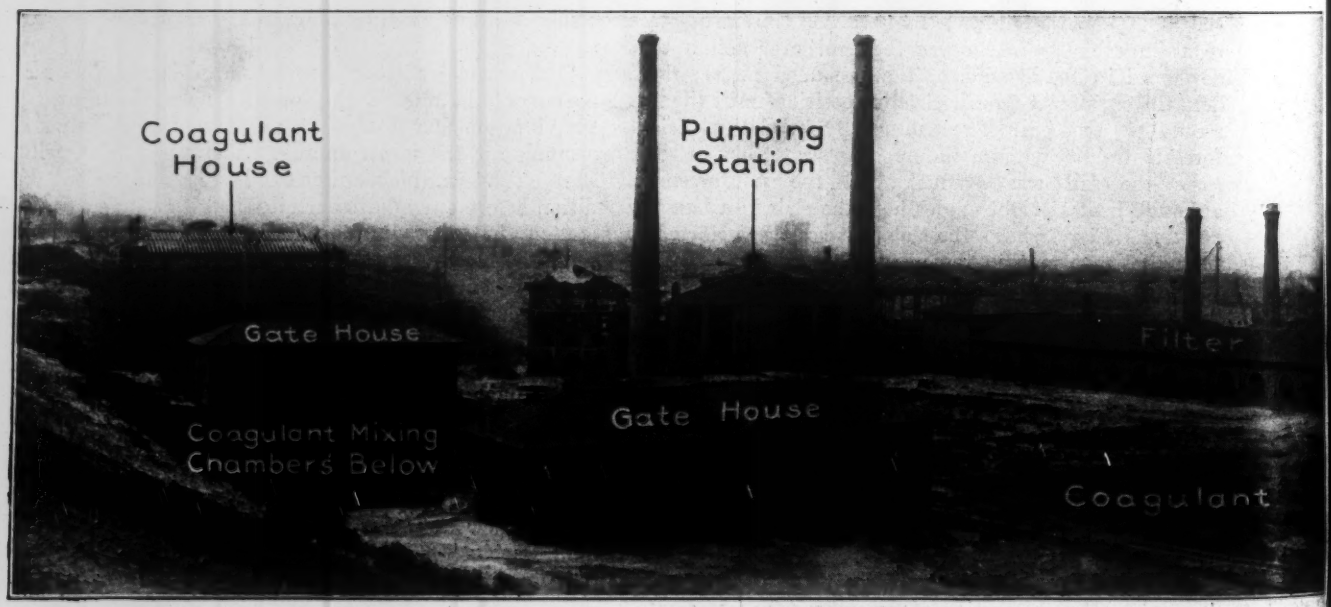


FIG. 1. GENERAL VIEW OF DIVISION AVE. PUMPING STATION, SOFTENING,

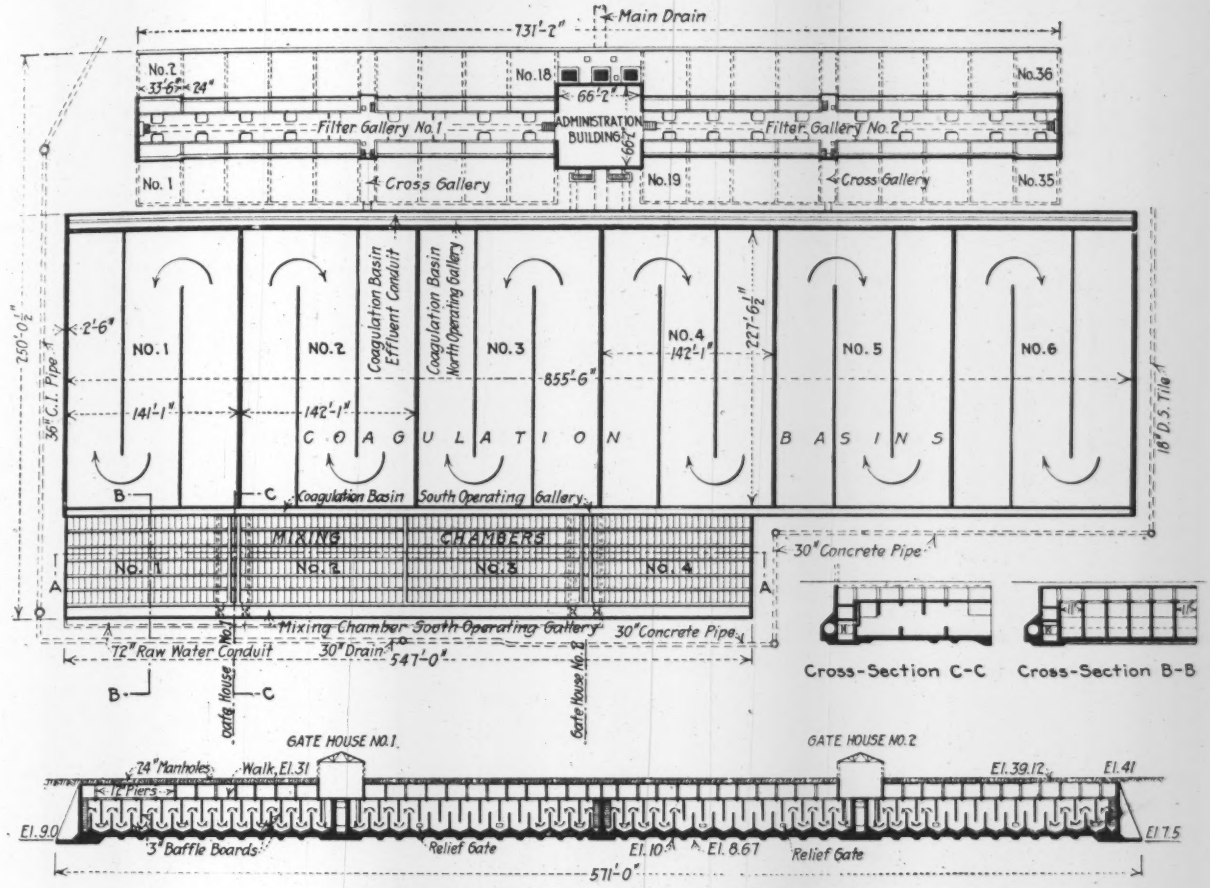


FIG. 2. PLAN OF CLEVELAND WATER-TREATMENT PLANT AND SECTIONS OF MIXING CHAMBERS

The lime solution is fed into the raw water just after it passes through a venturi meter on the 72-in. supply main. There are 12 lime-feeding nozzles, inserted vertically in the top of the raw-water pipe. These nozzles can be flushed with water under pressure. If this does not prevent stoppage, as indicated by a pet-cock on the feed pipes, the solution can be shut off by slide valves. Then the nozzle may be removed for cleaning.

COAGULATING AND FILTRATION PLANT FOR THE WATER-WORKS OF CLEVELAND, OHIO

The sulphate of iron from either of the two storage bins drops to a screen in a hopper and meets an upward current of water. The solution thus formed passes over a weir into a storage tank, from which it is pumped to orifice boxes, which are in duplicate. Ten of the 12 orifices connect one each to four mixing chambers and to the six coagulating basins. The other two orifices will be large enough to carry the whole dose to the desired point of discharge into the raw water. The solution from these two orifices will go into the raw water shortly after it leaves the low-lift pumps, or just before it enters the mixing chambers, so that iron can be introduced at any one of four points. In case the iron is admitted to the coagulating basin the point of introduction will be just after the water has spent two-thirds of its time in the basin, so there will be an opportunity to correct any excess of alkalinity. Even then there will be an hour's time for the coagulant to take effect. The iron solution will be passed through lead pipes.

There are four mixing chambers, each about 83 ft. wide and 135 ft. long, divided longitudinally by reinforced-concrete walls into six channels, baffled up and down with planks placed 5¼ ft. c. to c. The baffles are adjustable. This arrangement gives a water travel of about 2,100 ft., which it is expected will take about 35 min. (1 ft. per sec.). Two mixing chambers can be operated in series if extra mixing is desired.

The water from the mixing chamber is discharged into a channel that runs the whole length of the end of the six coagulating basins. From this channel the water can be introduced to any one of the basins. Each coagulating basin is about 142 ft. wide by 250 ft. long, with two baffle walls dividing it into three compartments longitudinally. It is expected that it will take about 3½ hr. at maximum capacity for the water to pass through a basin, on the basis of all six basins being in operation. This will give a working rate of about 25,000,000 gal. per basin.

The basins are of ordinary groined-arch roof and floor construction. Facilities for draining and cleaning the basins by water under pressure are provided.

From the coagulating basin the water is taken into a channel from which four outlets lead to an influent line. From the influent pipe the water flows to any one of 36

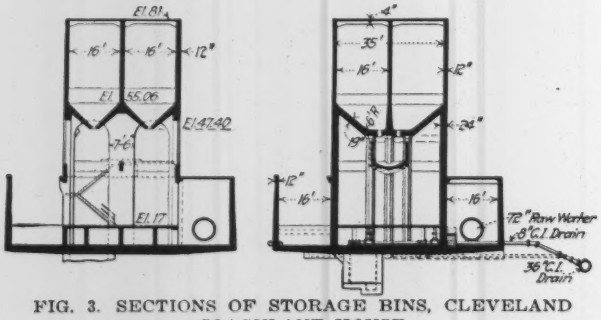


FIG. 3. SECTIONS OF STORAGE BINS, CLEVELAND COAGULANT HOUSE

rectangular filters, 33½x49 ft. in plan (see Figs. 2 and 4). The net filtering area is therefore 1,460 sq.ft. per filter. The filters are disposed in two rows of nine each, or 18 in all, on either side of a central administration building that is 70 ft. square. There is a pipe and operating gallery 24 ft. wide between each row of nine filters. The filtering material consists of 27 in. of sand on 22 in. of gravel. There is a manifold strainer system. The central manifold is of cast iron, elliptical in section, and the laterals are of 2½-in. cast-iron pipe provided with two rows of ¼-in. holes on the under side, bored at an angle of 45° with the vertical. The holes are designed to give an area of 0.33% of the sand area.

The water collected by the laterals and manifolds is discharged into a system of collector pipes under the

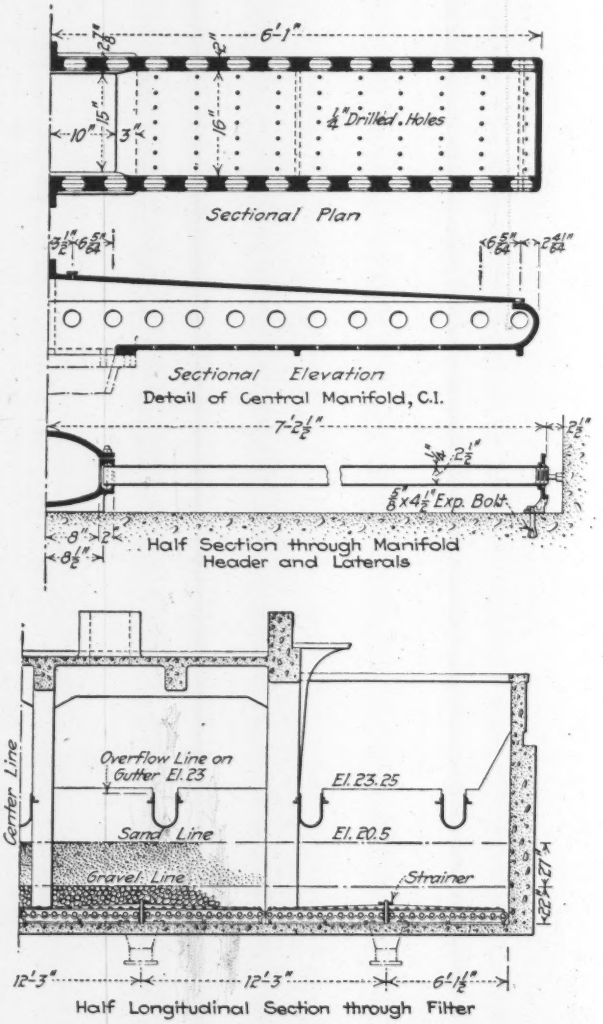


FIG. 4. DETAILS OF CLEVELAND FILTER UNIT AND STRAINER SYSTEM

filters. These connect into a single 24-in. pipe leading from each filter. The water then passes through a controlling device into the space beneath the filters. From there the water passes through a conduit to a 25,000,000-gal. clear-water basin about 1,000 ft. distant.

There is a covered wash-water reservoir of reinforced concrete holding about 450,000 gal., located on a hill about 50 ft. above the floor of the filter. Wash water is conducted to the filters through a line of 48-in. cast-iron pipe on which there is a Simplex meter for measuring the flow. This water will be introduced at the rate of 15 gal. per min. per sq.ft. of filter area, but no air will be used at present.

Dirty water will be taken from the filters over adjustable weirs on the wash-water troughs to and through

a 30-in. pipe to a main filter drain. It will eventually reach the old river bed, now an arm of the lake.

Provision is made in the administration building for a sand-storage bin, with room left for the installation of a sand washer in case it is found necessary for any cause to supplement the regular washing.

All sluice gates and the 10 large valves in the mixing chambers and coagulation basins will be electrically operated. All the filter valves (five for each filter) will be hydraulically operated. There will be heat in the filter building, but not in the mixing chamber. The pressure for hydraulic operation, controllers, etc., will be the regular city-water pressure.

The filter house is 733 ft. long, extending over the filter and operating gallery. It is a one-story structure, built of special wire-cut brick of varying shades, laid in dark mortar with joints raked out to a depth of ½ in. The other buildings are of the same kind of brick, giving a pleasing effect. The building over the filter gallery, about 50 ft. wide and one story high, has steel roof trusses covered with sheathing and red Spanish tile. The administration building in the center, about 70 ft. square and two stories high, has offices on the first floor and three laboratories and an office on the second floor. The chemical-storage bins and machinery for the preparation and introduction of solution of lime and coagulant are in a brick building of similar style of architecture. Over each pair of mixing chambers there is a small gatehouse in harmony with the other buildings. F. B. Meade, of Cleveland, acted as consulting architect. All parts of the plant not taken up with buildings will be covered with earth and grassed.

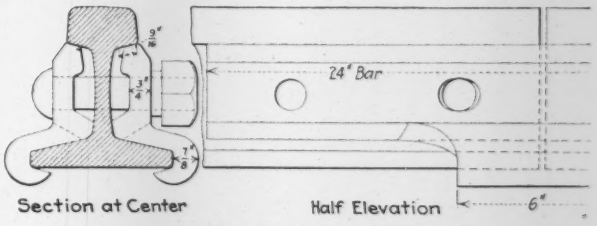
The filter equipment, except operating tables, was supplied by the M. L. Bayard Co., of Philadelphia. The operating tables were furnished by the Pittsburgh Filter Manufacturing Co. The filter controllers were made by the Builders Iron Foundry, of Providence, R. I.

A summary of the water-testing operations preliminary to the design of the plant appeared in *Engineering News* of Sept. 3, 1914. The purification and softening works were virtually completed in the summer of 1916, but cannot be put in full operation until the completion of the pumping station and the new intake tunnel. Meanwhile the plant is being "tuned up" under the direction of J. W. Ellms, of Cincinnati, who is dividing his time between the Cincinnati and Cleveland plants. It is not probable that the new purification works will go into full operation until some time in 1917, but possibly some 20,000,000 gal. or so may be supplied for treatment from the Kirtland pumping station, on the east side of the city. The city is now being supplied with chlorinated lake water from that station. It is expected that within a few years a filtration plant will be built at Kirtland.

FIG. 5. CLEVELAND LIME-SLAKING TANK
The Pelton wheel drives the pump and stirrer. The perforated bucket is shown in position to dump unslaked material

New Rail Joint of Grip Type

A rail joint now in experimental use is so designed that the splice bars transmit the pressure or load upon the rail head directly to the junction of the web and base of the rail. The bars have a vise-like grip on the rails at this point, instead of a wedging fit between the head and base of the rails. In this way they prevent relative movement of the two rail ends, both laterally and vertically. The object is to hold the rail ends in exact line and level, and thus to prevent battering and wear of the top and side of the rail heads, as well as to prevent wear of the contact surfaces of the splice bars and rail heads. At the same time the joint is flexible enough to conform to the wave motion of the track.



NEW GRIP RAIL JOINT
Used on the Chicago & Northwestern Ry.

The splice bars are 24 in. long, with four bolts, the alternate bolts having their heads on opposite sides of the rail. The end portions are of fishplate section, with the lower edge fitted to the fillet of the rail. The middle portion of the bar has a wide flange that fits closely upon the rail base, and a special feature of the design is that this flange has a rib that hooks under the edge of the rail base. Thus the bars cannot oscillate or rock upon their bearings at the rail fillet. Wear upon the top surface of the bar and the bottom of its flange can be taken up by tightening the bolts. This rotates the bars on their bearings, drawing the upper end inward and the flange upward, so as to maintain the two rails in proper level and line.

One of these joints is in use on 100-lb. rails near the end of a subway, where there is considerable wave motion in the track and where the traffic amounts to about 100 trains daily, with heavy equipment. During six months' service the bolts have not required tightening and the joint did not become low, so that no tamping or raising was necessary. The joint is the invention of A. L. Clapp, of Chicago, Roadmaster of the Chicago & Northwestern Ry.

The Standard Code of Boiler Construction formulated by the American Society of Mechanical Engineers will probably be adopted by the State of Louisiana. At the recent session of the legislature a bill was enacted authorizing the appointment by the governor of a commission of five experts to examine the code and report to the next legislature whether it should be enacted as a law. Recent specifications for boiler work for the Panama Canal have specified that the construction should be in accordance with the Mechanical Engineers' Code, with alternate bids on boilers not so constructed.

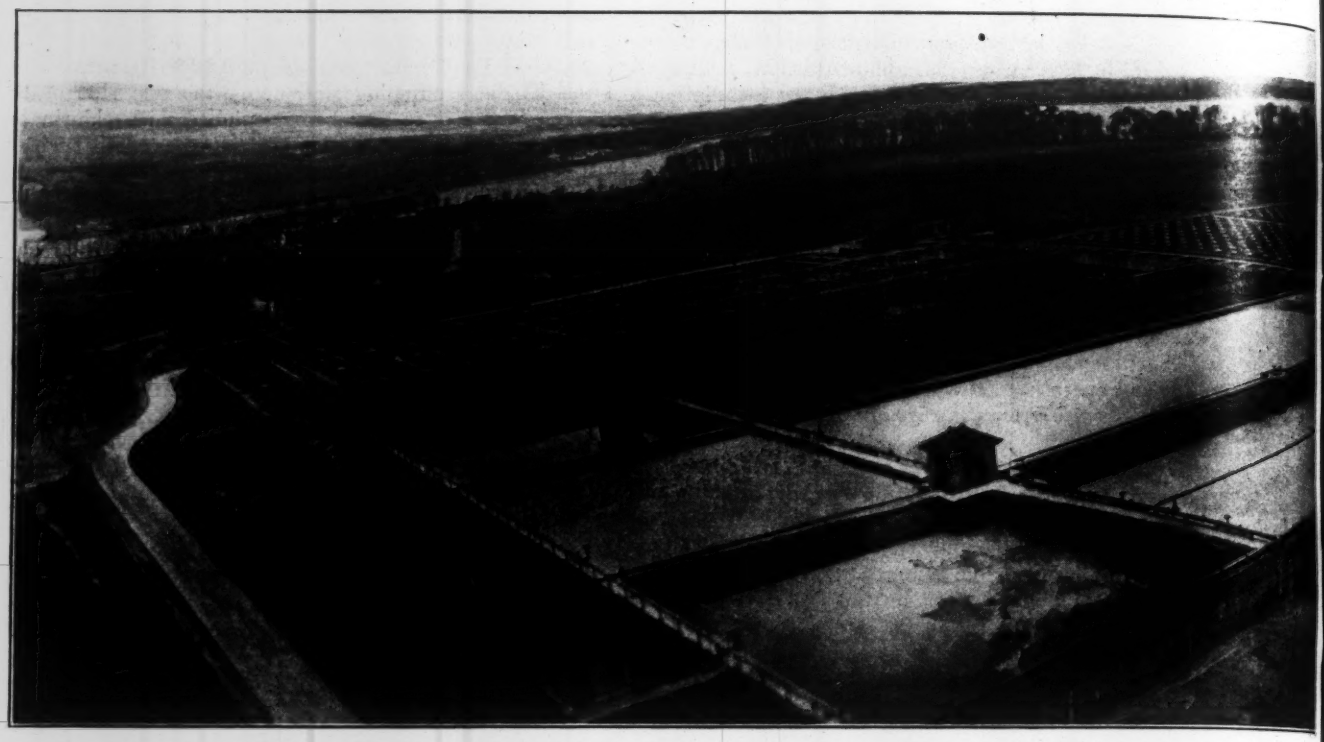


FIG. 1. GENERAL VIEW OF BACK RIVER SEWAGE-TREATMENT WORKS, CONSISTING OF HYDROLYTIC, IMHOFF AND

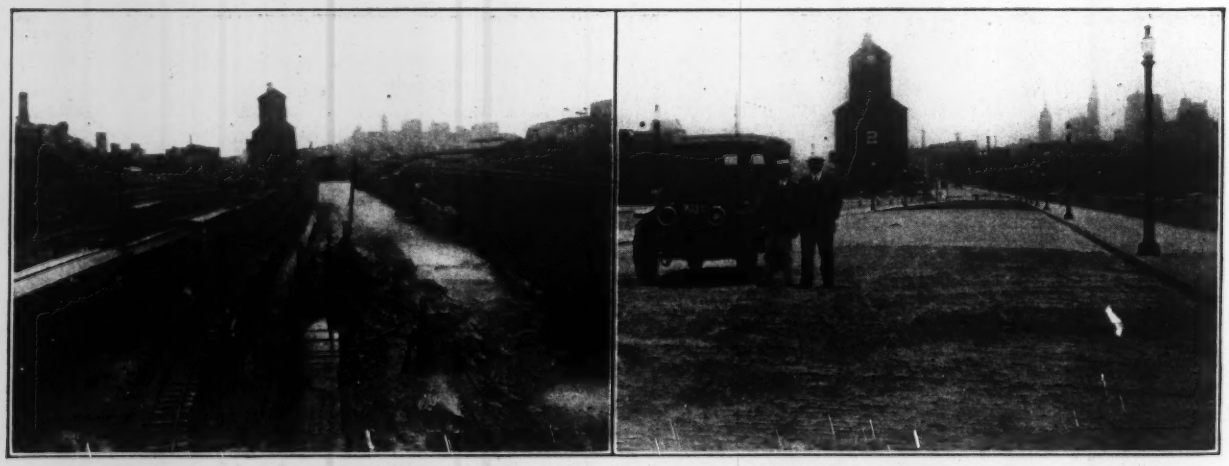
Completion of the Sewerage System of Baltimore

By G. J. Requardt*

This month sees the practical completion of the building of Baltimore's new sewerage system. From a condition where the city's wastes were poorly handled by means of cesspools and a few scattered private drains, and stormwater was allowed to flow down the street and alley gutters for great distances before entering inlets, the work of the Baltimore Sewerage Commission has wrought wonderful changes. Formerly, sewage was allowed to flow into the harbor, and the result was the harbor turned into an immense septic tank which gave off terrible odors whenever the backwater from the sidewheel excursion steamers stirred up the sludge on the bottom. At present, civic pride in the conditions surrounding the waterfront has been aroused to such an extent that the Harbor Engineer maintains a police system, and anyone detected throwing a watermelon rind or other unsightly floating object into the harbor is liable to arrest and a fine!

Baltimore began thinking of a comprehensive sewerage system for itself about forty years ago, but it was not till 1892 that serious study was given the subject. In that year a commission was appointed, headed by the late Mendes Cohen, Past President Am. Soc. C. E. The first report given out by this commission (1897) recommended that the city sewage be collected and disposed of by dilu-

*With Norton Bird & Whitman, Munsey Building, Baltimore, Md.



FIGS. 2 AND 3. THE ORIGINAL JONES FALLS CHANNEL AND THE FALLSWAY BUILT ABOVE IT AS PART OF BALTIMORE SEWERAGE PROJECT

Mayor Preston and Chief Engineer Hendrick are standing by the automobile in the view showing the completed Fallsway

SEPARATE SLUDGE-DIGESTING TANKS, SPRINKLING FILTERS, FINAL SETTLING BASINS AND SLUDGE-DRYING BEDS

tion with the waters of Chesapeake Bay. This scheme was strongly opposed as it was felt that the large shellfish layings in the bay would be liable to contamination. Another report, brought out in 1899, gave as an alternate scheme the disposal of sewage by irrigation. Kenneth Allen was principal assistant engineer of this commission.

In 1904 a new commission was created, a sewerage loan made, and Calvin W. Hendrick was appointed chief engineer to begin work on the design and construction of the system. The work started in 1906 and has been continuously carried on to date.

The system comprises about 800 mi. of sewers, storm-water drains, interceptors, force mains, outfalls, etc., ranging from 8 in. to 29 ft. in diameter; a pumping station that houses three 27,500,000-gal. pumps for raising the level of about one-third of the city's sewage flow; the immense disposal plant at Back River which consists of rough and fine screens, hydrolytic, Imhoff and separate sludge-digesting tanks, 30 acres of sprinkling filters, final settling basins, sludge beds and a power house.

A spectacular feature of the work of the commission consisted of covering over and building a beautiful boulevard on the top of Jones Falls, a stream 60 ft. wide flowing through the heart of the city and which for the last twenty years had been assuming the rôle of an open sewer.

The work has been completed in a little over ten years at a cost of about $23,000,000.

Some of the engineers connected with the work are: Calvin W. Hendrick, Chief Engineer, 1905-1916; Thomas D. Pitts, Division Engineer and Assistant Chief, 1906-1916; A. M. Brosius, Assistant Chief, 1906-1912; O. W. Connet, Division Engineer, 1906-1916; Alfred H. Hartman, Division Engineer, 1906-1916; Ezra B. Whitman, Division Engineer, 1906-1911; Herbert M. Knight, Division Engineer, 1906-1910; Kenneth Allen, Division Engineer, 1906-1908.

Are Bleeding Wood Blocks Really Bleeding Joints?

By Ellis R. Dutton*

An experimental strip of creosoted wood-block paving in Minneapolis, on 15th Ave., S. E., was laid on June 23 and 24, 1915, using blocks that were treated by the Kettle River Co. about 10 days before. There was laid under this special test about 250 sq.yd. of blocks. These blocks were laid in the regular way, except that instead of a pitch filler a sand filler was used. The object in doing this was to determine how many of the difficulties attributed to the bleeding of blocks are due to the blocks themselves.

Upon examination of this pavement at various times since it was laid, but very little bleeding has been noticed. Probably not 5% of the blocks have shown any exudation, and then only slight. On the remainder of the street, where the joints were filled with pitch in the ordinary way (by flooding and squeegee) and the pavement was covered with sand, the blocks became quite sticky, and it was necessary to cover them a second time with sand.

In the treatment of these blocks an oil of a specific gravity of about 1.11 was used, and the treatment was continued for 9 or 10 hr.

This contrast of results with the same blocks in the same pavement shows that almost all the trouble attributed to the bleeding of creosoted wood blocks is actually not in the bleeding of the blocks themselves, but in the pitch filler used in the joints; and it also shows further that if the blocks are treated with a tar creosote oil, using more than 16 lb. per cu.ft., there is very little bleeding on account of the oil. If the treatment has been properly done so that the blocks are subjected to the proper penetration, the bleeding is reduced to almost nothing.

*Assistant City Engineer, Minneapolis, Minn.

Building Albany Sewage Pump House and Grit Chamber

By Stephen B. Vernon*

The design of the grit chamber, Imhoff tanks and sewage-pumping station for Albany, N. Y., was very adequately treated in articles by John H. Gregory, in *Engineering News* of Oct. 7, 1915, p. 692, and June 22

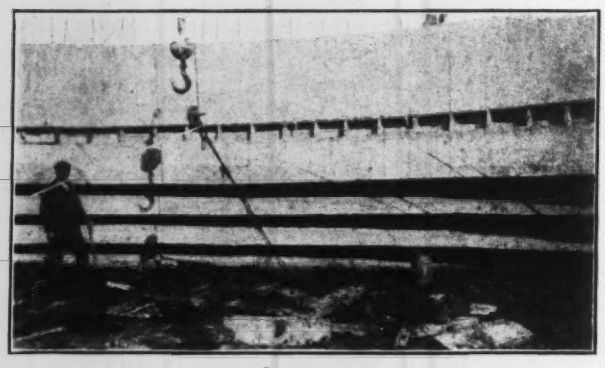


FIG. 1. INSIDE OF CUTTING-EDGE SECTION, SHOWING REBATES AND KEY FOR FLOOR

and 29, 1916, pp. 1164 and 1224. The writer has a word to say here about the construction of the pumping station and the grit chamber.

The contract for construction was awarded to the Foundation Co., of New York, on Sept. 13, 1915. It seemed a late day in the season to commence such work; but plant was soon assembled, and about a month later a real start had been made.

The surface of Westerlo Island lies from 10 to 12 ft. below the highest recorded high water in the Hudson River. For periods of a few days during the early spring months the island is often inundated—usually to a depth not in excess of 4 or 5 ft. There is a considerable deposit of silt on the island, and the top soil has a depth of from 5 to 7 ft. Under this is a sand, so fine in grain that it bears a close relation to quicksand, to a depth of some 35 ft. below the surface, and then gravel, running from fine to coarse, to rock.

*Engineer, Intercepting Sewer Design and Construction, City Hall, Albany, N. Y.

FIG. 2. EXTERIOR OF WESTERLO CAISSON

The pumping station has a cylindrical substructure, 62 ft. in inside diameter, with an inner cylindrical dry well for the pumps, 38 ft. in diameter, and an outer annular suction well 10 ft. in width. The main floor of the station, dividing the superstructure from the substructure, is 2 ft. above the highest known high water of the river, 23 ft. above mean low tide, and stands 13 ft. above the former ground surface. The top of the foundation floor is 44 ft. below the main floor—that is, 31 ft. below the former ground surface, with a hydrostatic head against it of 23 ft. of groundwater.

Neither the plans nor the specifications for the work provided a method for building the substructure. This was understood to be optional with the contractor, the scheme to be approved by the engineer. Discarding the usual method of sheetpiling the excavation, the Foundation Co. proposed to sink the outer concrete wall as a caisson, to excavate under water with clam-shell buckets as the weight of the caisson carried it down, to deposit the concrete bottom as a seal under water and lastly to build up the inner parts of the substructure. The contractor was reluctant, as he expressed it, to undertake to pump the Hudson dry by a system of under-drainage—for one sees, from what has been said,

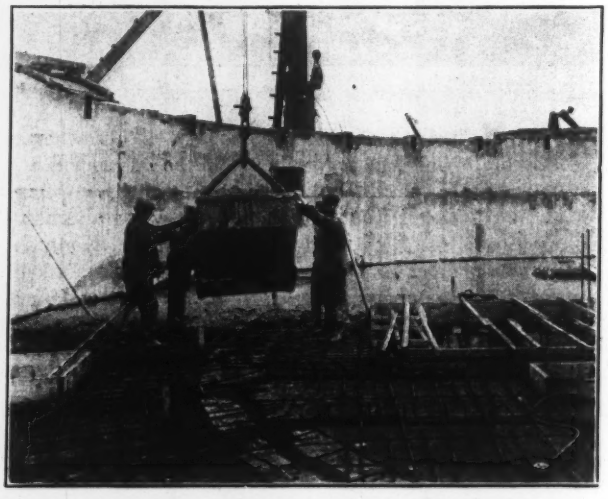


FIG. 3. CONCRETING THE BASEMENT FLOOR

that the foundation of the station lies in the gravel stratum far above rock. Other contractors, however, had the more usual scheme in mind, and the very design of the building indicates that this had been contemplated.

This method of construction necessitated certain departures from the design—as described by Mr. Gregory. The outer wall, instead of having a maximum thickness of 3 ft. and a thickness of 2⅓ ft. at the ground surface, was built with a uniform thickness of 4 ft. for about half its depth, and was then offset to the original dimensions. It was heavily reinforced, moreover, by horizontal circumferential rods and vertical rods 1 in. in diameter, which were introduced to resist the torsional stresses anticipated in sinking the caisson, whereas the design contemplated no steel reinforcement for the outer cylinder. The steel used in the design, however, was necessarily omitted from the foundation floor, and the concrete thickness was increased at the center of the station from 4¼ to 10 ft., so as to make of the bottom a large plano-convex disk. It was obviously impossible to provide an outside

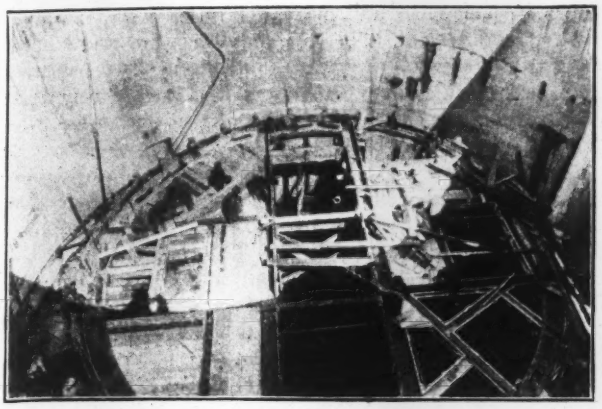


FIG. 4. FORMS FOR ONE OF INTERIOR FLOORS OF PUMPING STATION

footing, and the foundation floor was keyed into the caisson by a series of offsets.

The details and photographs which accompany these notes show the essential features of the work, with little need of further description. And since no layout of the plant has appeared with former articles, the general layout is here reproduced. The construction-plant layout indicated on the latter will also, perhaps, add to the reader's interest.

Caisson Easily Sunk

Very little difficulty was found in sinking the caisson. Toward the end of the operation it was at one time necessary to add an extra load of sand bags to the weight of the concrete, but otherwise the caisson sank evenly of its own weight. As to the method of procedure, the surface excavation was carried to a depth of 5 ft. before the shoe was placed, and the wall was built up in sections about 12 ft. in height, each section being sunk and the forms removed before the next concrete section was built upon it. The time required for changing the forms and placing the steel was such as to allow the concrete to set sufficiently between the periods of sinking. The quantity of concrete placed in any one day ranged between 60 and 100 cu.yd. The section, of course, was not truly cylindrical upon completion, but the warp was so small as to limit the variation in diameter to about 3 in. over or under the plan dimensions, and the footing came to a rest within a fraction of an inch of the position intended for it.

Nor was difficulty encountered in placing the seal. The concrete was deposited by deep-sea buckets and was allowed to set for a period of three weeks before the water was pumped out. The leaks discovered were minute, but nevertheless, in order to give a perfectly dry pump well, the inner well floor and the side walls also between the two lowest floors were later waterproofed by The Waterproofing Co.'s method of applying a compound coating about 1 in. thick.

Questions have been asked so many times about the thickness of laitance on the concrete seals that it may be well to say it was necessary to clean off about 6 in. of the deposit before reaching a sound concrete. Wherever these seals were used, allowance was made for a surface finish coat about 6 in. thick.

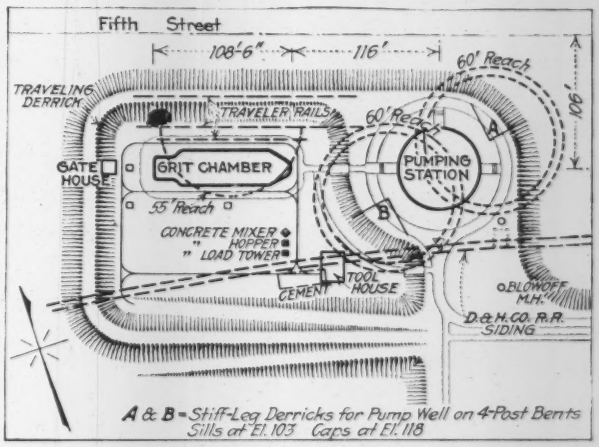


FIG. 5. CONSTRUCTION PLANT LAYOUT OF ALBANY SEWAGE WORKS ON WESTERLO ISLAND

The seal once completed, the construction of the inner wall and the columns and floors was merely a matter of routine. This work was all heavily reinforced with

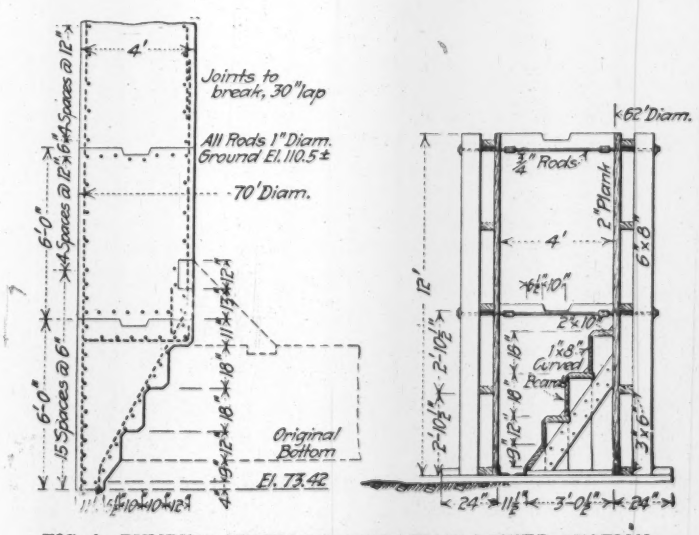


FIG. 6. PUMPING STATION FOUNDATION; LOWER SECTION OF WALL AND FORM

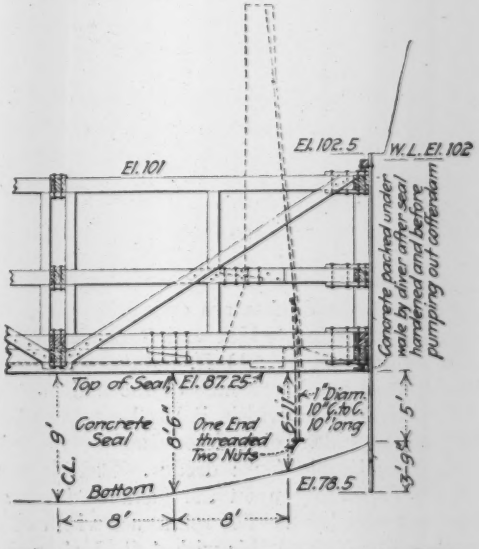


FIG. 7. SHEETPILE COFFER-DAM FOR GRIT CHAMBER

steel, and the concrete itself, as well as that in the outer wall and seal, was a 1:2:4 mixture.

At the present writing the superstructure is well toward completion. It follows in plan the size and shape of the substructure, of course, with a circular monitor about the diameter of the inner dry well. The face brick are Hytex tapestry effect, and the inner face of the walls will be plastered, the lower 6 ft. being tile covered. On the conical roof there is a cinder concrete slab, covered with a Nalecode coat and finished with red tile.

How the Grit Chamber Was Built

The excavation for the grit chamber was sheeted with steel sheetpiling; the timber framing and steel piling were carried down as the excavation progressed, and a concrete seal was then laid under water. The walls, finished floor and other parts were constructed thereafter. The excavations for the deep conduits connecting the gate house, grit chamber and pumping station were similarly sheeted and sealed. The grit-chamber walls were built as cantilevered retaining walls, and the concrete, as well as practically all other concrete on the work except that in the conduits, where a 1:2½:5 mixture was used, was a 1:2:4 mixture.

As to the contract costs of the work, all excavation below groundwater level was priced at $3.50 and that above this level at 60c. per cu.yd. Concrete ranged between $9 and $15 per cu.yd. The cast-iron pipe, the iron castings, steel reinforcement and other metal incorporated in the work of course brought higher prices than would be expected in normal times.

The superstructures were sublet by the contractor to the Peter Keeler Building Co., of Albany. The writer has been in charge of the work for the city, under Frank R. Lanagan, city engineer, and Wallace Greenalch, commissioner of public works.

Building Six Hundred Miles of Drainage Ditches

SYNOPSIS—All the work is done by about 26 dipper dredges of various sizes. A notable feature is that the dredges are required to make cuts with slopes of 1:1. The method of attaining this is described. The engineers and contractors use motor boats to get over some of the work. Supplies are taken in on motor scows and on stern-wheel barges.

The Little River Drainage District, in southeastern Missouri, will have about 625 mi. of drainage ditches in its area of 500,000 acres. These ditches will drain the low lands and provide for carrying off the normal rainfall over the district, which averages 39.8 in. annually. The flood waters formerly discharged into the district by rivers at its north end will be excluded entirely, being cared for by extensive river diversion works, with flood detention basins and a channel extending eastward to the Mississippi River, as described in *Engineering News*.

Fig. 1 is a map of the district showing the ditch layout. The ditch system involves about 34,250,000 cu.yd. of excavation, at an estimated cost of $2,706,000. The work is divided between a number of contractors, and it is expected that it will be completed by 1918. The character of the work is indicated by the views in Fig. 2.

Size and Layout of Ditches

Some of the ditches are of notable size. They range from 4 ft. bottom width and 8 ft. depth at the upper ends of laterals, to 123 ft. bottom width and 8 to 12 ft. depth at the lower ends of the main ditches. While 4 ft. is a specified width, it has been exceeded as a rule, the bottom width being determined by the minimum top width practicable for a dredge. This is usually 20 to 24 ft., depending upon the distance from ground surface to water level. The minimum width of dredge hull is about 14 ft., and this with 4 ft. draft and water level 1 ft. below the ground would give a top width of 24 ft.

The district is long and narrow, with a length of about 90 mi. (north and south) and a width of 10 mi. To serve this area the ditches are divided into three groups, as shown in Fig. 1. The group in the upper portion of the district is served by a main ditch extending nearly the full length of the middle of the district, being over 90 mi. long. This has a bottom width of 4 ft. (nominal) at its upper end and 123 ft. at the lower end. The two other groups are in the lower portion of the district, and each is served by a main ditch parallel with the central ditch. These three parallel ditches are about ¼ mi. out to out. They leave two strips of unavailable land, but in planning the work it was thought that this width might not be more than sufficient for disposing of the soft soil and keeping it back from the channels.

The width of cleared right-of-way ranges from 100 ft. on the laterals to 350 ft. on the main ditches. In this work a small amount of timber in the form of saw-logs has been salvaged by landowners and timber leasers ahead of the clearing, and by subcontractors in connection with the clearing. The use of the ditches for floating timber is prohibited. At some points an unstable soft black soil is encountered, which churns into slush under the action of the bucket so that the bottom cannot be finished to grade line. It has been suggested that a small hydraulic dredge may be used later to remove this soft slush from the bottom.

On the laterals, the spoil banks have openings 500 ft. apart (alternating on opposite sides) for the escape of surface water to the ditches. On the main ditches the spoil banks are placed on both sides to provide for the ditches running more than bank full. The minimum top width on the laterals is about 20 ft., or just wide enough for a dredge boat. The maximum top width is 140 ft., with a 10-ft. berm on each side, or 160 ft. between spoil banks.

All work is done by floating dipper dredges, with bank spuds for the smaller, and bank or bottom spuds for the larger machines. The laterals are cut mainly by dredges with 1-yd. buckets. For the main ditches, a 1-yd. dredge

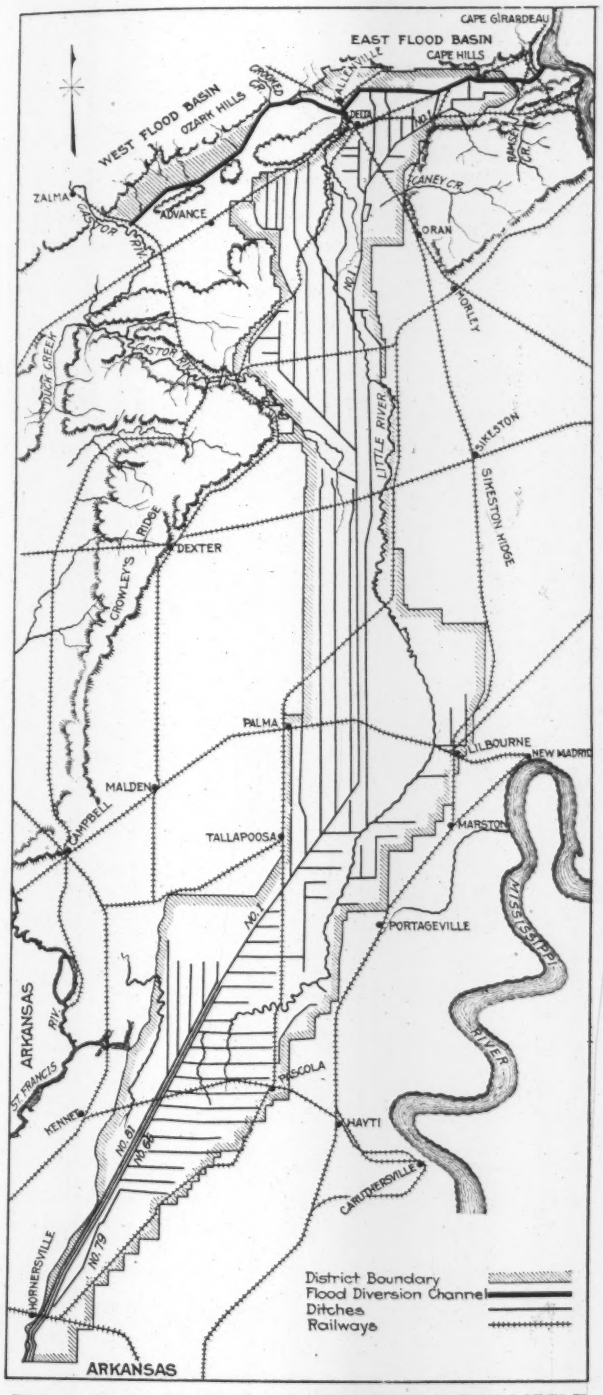


FIG. 1. PLAN OF 600 MI. OF DITCHES FOR THE LITTLE RIVER DRAINAGE DISTRICT, MISSOURI

makes two pilot cuts 6 ft. deep, one on each side. These are about 22 ft. wide on top and 12 ft. on the bottom, with the 1:1 ditch slope on the outer side. A larger dredge first extends each pilot cut to the full depth and then takes out the center. In this way five cuts are made for the complete section. On the big ditch (No. 1) with 123-ft. bottom width a dredge with 4-yd. dipper has made a record of 83,278 cu.yd. in 26 working days.

On one residency there are no less than twelve dredges with dippers ranging from 1 yd. to 4½ yd. capacity. The other two residencies have eight and six dredges each. The larger ones are mostly Marion machines, though some are built from designs of the contractors and have combinations of parts by different makers. Others are by the Fairbanks, Monighan, American Steel Dredge, and other makers. Most of them are operated by steam.

The dredge men work mainly in two 12-hr. shifts. The day shift is from 6 a.m. to 6 p.m., with an hour (or less) at noon for lunch and oiling. The men live in double-deck quarter-boats, built on the work. For getting over the work the engineers and contractors use fast motor boats and slower motor launches with single-cylinder engines. For taking in material and supplies there are motor scows and home-made stern-wheel barges. These latter have gasoline engines mounted either longitudinally or transversely and driving a shaft with chain drive to a sprocket on the stern-wheel shaft. One of the larger barges has an 8-hp. engine. The quarter-boats and stern-wheel barges are shown in Fig. 2.

Dredging Ditches with 1:1 Slopes

A specially interesting feature of the work is that by the specifications the dredges are required to finish the cuts with 1:1 slopes. On ditches of this kind the usual practice is to excavate them to practically a U-shape, and let the sides cave in. This results in rough cuts and obstructed bottom. Mr. O'Brien considered that the ditches should be and could be excavated with proper slopes, as stated in a paper by him in *Engineering News*, March 23, 1916.

Some trouble was experienced at first in getting the dredge men to do the work as required, but after a little explanation and requiring them to go back and dress the work not properly finished, they soon came to understand how to get the desired results. This is accomplished by taking a succession of light cuts on each side in such a way as to approximate the 1:1 slope, and then to excavate the center or core.

The diagram issued for instruction as to this slope cutting is shown in Fig. 4. The prism is cut by digging the corners first and working to the center, and it is especially insisted that light cuts must be taken in digging the corners, as indicated on the cross-section. The roll from the berm is cleaned on completion of the fifth round.

Features of the Work

The contract sets forth that completion of the work within the time provided is of special importance. With this in view it is specified that any contractor, before beginning the erection of a dredge, must obtain the engineer's approval of its size and capacity. This is in order to prevent the use of dredges of insufficient capacity to make the required progress. It is for the same purpose that the monthly record is made of the estimated and actual progress on each contract, as noted later.

The specifications provide that the work is to be staked out in advance by the engineer to show the exact location and width of right-of-way, the ditch, the berm and the levees. The depth of cut for a ditch and height of fill for a levee are to be marked on the stakes. In dredging, many of these stakes are displaced or pulled out, and careful contractors mark the location and replace them or get the engineer to reset them so as to avoid excess cutting and to approximate their work to the required cross-section.

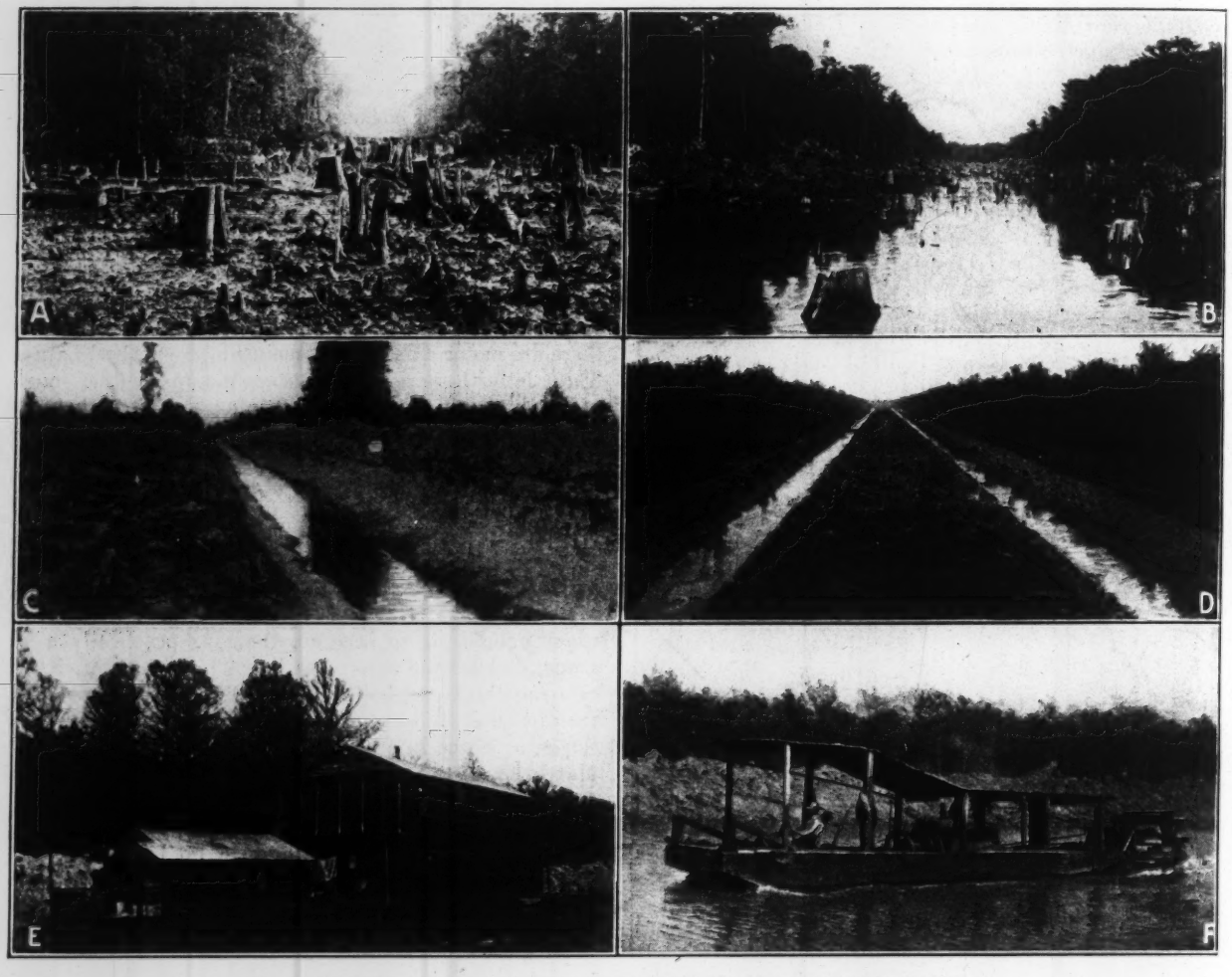


FIG. 2. DITCH WORK ON LITTLE RIVER DRAINAGE DISTRICT, MISSOURI

A—Clearing right-of-way for ditch. B—Cleared right-of-way overflowed. C—Typical small ditch. D—Excavation for main ditch No. 1. The two small channels are the pioneer cuts at the sides; the large dredge takes out the material between them. E—Quarter-boat for crew of dredge. F—Home-made gasoline stern-wheel scow for contractors' use

The cutting of small ditches to greater widths than those specified (in order to admit floating dredges) has been mentioned. The specifications provide that when the prism is not of sufficient width to accommodate the dredge installed, the necessary width shall be obtained when possible by flattening the side slopes. Increasing the prism of ditches is permitted, subject to the approval of the engineer, but the increased prism must conform to the specified section (except in area), and payment is made only for material within this section.

In moving dredges from one piece of work to another it may be necessary for one contractor to pass over work which has been let to another contractor but has not been constructed. In such cases the former makes a cut sufficient for the passage of his dredge and is paid for this on the basis of volume actually removed at a price ½c. per cu.yd. below that of the contract price of the other contractor. The ½c. deduction is paid as compensation to the latter.

In some places where ditches are in bog land it is anticipated that it will be necessary for the contractor to make several cuts before the ditches assume their final set or section. It is provided that in such case the contractor shall go over the work again and make such additional cuts as may be directed by the engineer, payment for the additional work being on the basis of actual cost plus 15%.

The entire right-of-way is to be cleared, stumps left on the berm being not more than 2 ft. high. The area

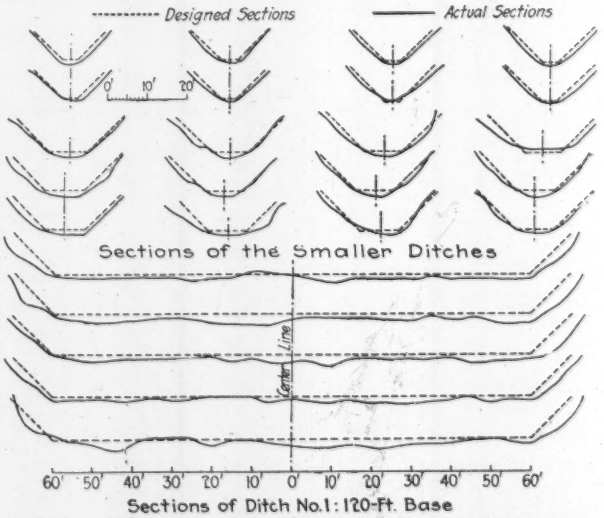


FIG. 3. TYPICAL DITCH CROSS-SECTIONS, AS PLOTTED IN THE FIELD

for base of levees is stripped and grubbed, and all stumps cut to within 6 in. of the ground.

Where the levee or embankment is to hold back a head of water the surface at the base is to be plowed or broken so as to bond with the material of the fill. Embankments of dry material must be made in layers of full width and over 12 in. thick, each layer being compacted by rolling, tamping or driving animals over it. Where the fill is of plastic material deposited by dipper dredges, it must be made in layers averaging 24 in. thick, and the material must be dropped at least 8 ft. in order to make a compact fill.

Cross-Sectioning and Progress Records

The cross-sectioning of the ditches is done by sounding, taking measurements at the top, middle and bottom of each slope, and at 5-ft. intervals on the bottom for large ditches and 3 ft. for the small laterals. Instead

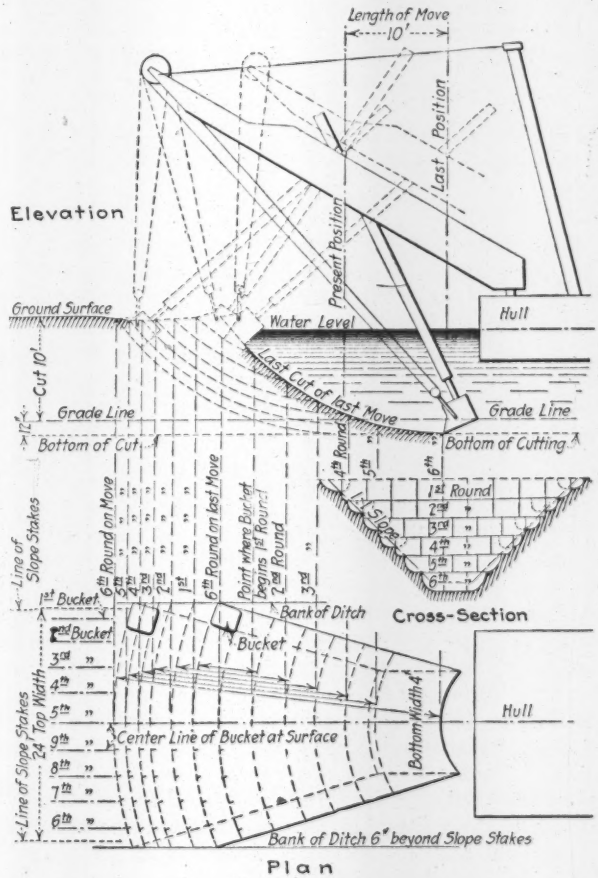


FIG. 4. DIAGRAM SHOWING HOW TO DREDGE DITCHES WITH SLOPES OF 1:1

of entering the figures in a book to be plotted later, the diagrams are plotted directly upon sheets of thin section paper, 17x10 in., clamped to a stiff board, the vertical and horizontal scales being 1 in. to 10 ft. This eliminates much of the office work, and blueprints from the diagrams are very useful and effective in showing the contractors just what results they are getting and how these may be improved.

Typical diagrams from these plotted cross-section sheets are shown in Fig. 3, for both the large and small canals. These indicate the character of the actual excavation and the closeness with which the channels can be excavated to the theoretical section. In the smaller ditches the bottom is invariably concave instead of flat, but soon fills up practically to the grade line.

At the main office estimates are made of the amount of monthly excavation required for proper progress, and contractors not meeting requirements are notified as to the amount (and percentage) by which they are below the estimates. This assists materially in the progress of the work.

The Chief Engineer of the Little River Drainage District is William A. O'Brien, of Cape Girardeau, Mo. On the ditch system, William Mulholland is locating engineer and Blair Boyle, E. S. Blaine and Howard Henderson are resident engineers. The party on each residency consists of an instrument man, a rodman and from one to three chainmen. Each residency has its headquarters in a town from which there is the best railway service to points convenient to the location of the dredges. The parties make use of trains, hand-cars, motor boats, push boats, automobiles and teams (besides walking and wading) in getting over the work.

A Defective Bascule Bridge

A recently constructed bascule bridge of modern type, which has been in operation less than half a dozen years, exhibits defects so serious as to threaten its safety and stability, according to an examination recently made by an engineer representing the designers of the bridge. It is charged that the pile foundations of the bascule pier have allowed the pier to move laterally an inch or more and that the span and machinery are now sufficiently out of adjustment so that both the steelwork and parts of the machinery have suffered damage. The designers charge that this is due to lack of proper adjustment before the bridge was put into operation. The essential points reported are the following:

The bascule span is completely out of balance, the counterweight being heavy. It takes 25 amperes to start the lift; but after starting, the amperage drops to zero, and as the bridge raises the brake is necessary to control its momentum. In closing the bascule the amperage averages 100.

The main rack pinions on opposite sides of the bridge are not timed with each other. The result is that the downstream motor does all the work of opening and the upstream motor all the work of closing the bridge. This causes vibration, and also must produce a serious twist in the structure.

On the upstream side the bearing of the pinion engaging the main pinion gear is held by four anchor bolts to the flanges of a girder. These flanges are torn almost through at the rear, owing to the unbalanced condition of the bridge and to the fact that the one motor closes the bridge.

The outer end of the bascule span is about 2¼ in. off center, and the spans back of the trunnion end of the bascule show such relative movements as prove that there has been a movement of the bascule pier upstream.

All the accessible anchor bolts on the bascule span are loose and can be readily lifted out by hand. There is no evidence that wedges were ever placed in the ends of these bolts or that any of these bolts were grouted. The top anchor bolts on the inside main trunnion bearing upstream have been sheared off.

As a result of the examination it was reported that the bridge was in imminent danger of accident and that steps should be taken at once to correct the trouble. The city officials have not followed this recommendation up to the present, although the report was made some two months ago.

It is believed that the conditions at the time of building the bridge were such that the construction work did not secure proper supervision.

Engineering Literature

Earth Pressure, Retaining Walls and Bins

Sir—My attention has just been called to a review of my book on "Earth Pressure, Retaining Walls and Bins" in *Engineering News* of Aug. 17, 1916, by Edward Godfrey.

Leaving out any controversial matter, it seems proper to correct some errors of statement of Mr. Godfrey relative to the text. Thus, the nomenclature used in connection with the tables, pages 116-120, is not simply scattered throughout the volume, as Mr. Godfrey seems to think, but is all to be found on pages 107-110. Most of the symbols used are to be found on page 107, including K and K_1, since these are defined by the equations $E = Kwh^2$, $K_1 = K \cos \lambda$. The remaining symbols are a, θ and A, which are defined on pages 109-110.

In connection with the counterfort, the text, pages 163-164, makes it plain that the horizontal rods of the counterfort are supposed to be "continuous U-rods" passed around or through vertical steel angles placed near the exposed face of the vertical slab. The angles were not shown on Fig. 54, as the addition would have confused the figure.

Mr. Godfrey states that the vertical slab, Fig. 54, "is reinforced all the way from top to bottom with continuous rods near both front and back face, with equal area of steel." Neither the drawing nor the text warrants this statement, the drawing showing ⅝-in. rods near the front face and ⅜-in. rods near the back face—the latter being a part of the temperature reinforcement, as explained on page 164. Next, Mr. Godfrey states that "the base slab is reinforced near both top and bottom all the way." The text calls for no reinforcement near the top, and no bars, with their spacing, are indicated on the drawing, Fig. 54. Near the bottom, usual practice is followed in extending one-third of the bars to the toe reinforcement to the rear.

Appendix I contains two approximate solutions of toe and heel beams (with or without fillets) and cantilever beams. The solutions of toes and heels, with the reinforcing rods in one plane, are very simple. For the heel with a fillet, with the usual rods inclined to each other, the more general solution is required. Contrary to Mr. Godfrey's opinion, it certainly seemed appropriate to apply this general theory to the cantilever beam, as is done, pages 251-252, "for the purpose of gaining an idea of the actual stresses involved," though a rough approximation is recommended in practice and used in the design.

Mr. Godfrey again states: "On page 127 a section of a retaining wall cut from point A downward to the right does not touch any steel, though this section is under heavy bending stress. The same is true of the figure on page 140." Both of these statements are absolutely wrong. The reinforcement for the toe, Fig. 46, page 127, is computed on page 131 and that for the toe, Fig. 48 (a), page 140, on page 142.

From the foregoing notes, it will be seen that there are so many misstatements in this review that the writer feels impelled to correct them, particularly as the chapter criticized was an earnest attempt to analyze more carefully than usual the stresses in reinforced-concrete retaining walls.

WILLIAM CAIN.

Chapel Hill, N. C., Sept. 25, 1916.

Sir—I have before me Prof. William Cain's letter commenting on my review of his book and beg to reply briefly.

Professor Cain finds the symbols used in pages 116-120 mentioned in the text and used in equations within ten pages of the tables. The use of a symbol in an equation does not define it, and a search through the text to find others is the very thing that I criticized as being exasperating.

Concerning the anchoring angles in the retaining wall, his text does not state that they are to be used, but merely that they are "one simple way." The figure certainly does not indicate that they are used.

Concerning Fig. 54, my review is in error in stating that the same area of steel is used near front and back of the vertical slab. The same number of rods are used, but they are of different diameter. These questions still remain unanswered: Why all of these rods to reinforce a slab in bending in only one direction? Why the double reinforcement of the horizontal slab? Why any reinforcement under the vertical slab, where no bending whatever can exist? Why reinforce the lower face of the left-hand portion, where the load is upward?

Concerning the walls on pages 127 and 140: Cut a section at 45° from A downward to the right in the former and from C in the same direction in the latter. No steel whatever is cut. These are sections of heavy bending. The rods should run farther to the right to reinforce these sections. Breaks are not always accommodating enough to occur on vertical planes calculated in the text. Professor Cain makes the strong assertion that my statements are absolutely wrong and cites the portion of the text that seems to prove it. This is an unfortunate citation, for the text makes it worse than Fig. 46. The reinforcing rods, by the text, are required to extend only 2½ ft. to the right of A, whereas if they extended 4 ft. they would still not be cut by a section at 45°. Professor Cain merely extends the rods for anchorage, but he overlooks the fact that beyond the point where this anchorage is satisfied there is still need of reinforcement. This is a very common error of designers.

EDWARD GODFREY.

Pittsburgh, Penn., Oct. 4, 1916.

Indexing Technical Literature

Sir—Your review of the "Industrial Arts Index," p. 313, issue of Aug. 17, 1916, would seem to imply that we index by title rather than by subject matter.

In citing the example of the Imhoff tank it is true, as you say, that there is a good deal of material on Imhoff tanks under the general heading of Sewage Disposal.

Under every broad subject heading is to be found material on particular divisions or phases of the subject. Our plan is to *read* the article, place it under the subject heading which best covers its contents and to bring out also, under proper subject headings, parts of the article that are of sufficient importance to be indexed.

If an article covers Imhoff tanks only, it would be put under that subject heading. If it is an article on the general subject of sewage disposal, in which there is enough about Imhoff tanks to warrant an added entry, the article is indexed both under Sewage Disposal and Imhoff Tanks. A large amount of this analytic work is done.

As to there being no reference from Imhoff Tanks, it is not the practice of many professional indexers to make references from specific headings to those of a general nature. We find, however, that they are often useful, and the omission of a reference from Imhoff Tanks to Sewage Disposal was an oversight—due to the fact that the first entries under Imhoff Tanks were duplicated under Sewage Disposal. You will notice, too, that in five of the entries under Imhoff Tanks the titles do not contain the words of the heading.

H. W. WILSON,
President, H. W. Wilson Co., Publisher.
White Plains, N. Y., Sept. 6, 1916.

REVIEWS AND NOTES

Recent Highway Literature

ELEMENTS OF HIGHWAY ENGINEERING—By Arthur H. Blanchard, M. Am. Soc. C. E., Professor in charge of the Graduate Course in Highway Engineering in Columbia University. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. xii + 514; 202 illustrations. $2.50 net.

HANDBOOK FOR HIGHWAY ENGINEERS: Containing Information Ordinarily Used in the Design and Construction of Roads Warranting an Expenditure of $5,000 to $30,000 per Mile. Part I, Principles of Design. Part II, Practice of Design and Construction—By Wilson G. Harger, C. E., First Assistant Engineer, New York State Department of Highways, and Edmund A. Bonney, Supervising Engineer, New York State Department of Highways. Second edition, entirely revised and enlarged. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd., 6 and 8 Bouverie St., E. C. Leather; 4x7 in.; pp. 609; illustrated. $3 net.

THE AMERICAN ROAD: A Nonengineering Manual for Practical Road Builders—By James I. Tucker, Professor of Civil Engineering, University of Oklahoma, and Consulting State Engineer, Oklahoma Department of Highways. Norman, Okla.: Publishers, "The American Road." Cloth; 5x8 in.; pp. x + 235; illustrated. $1.08 by mail. Sold by booksellers and publishers.

THE CONSTRUCTION OF ROADS AND PAVEMENTS—By T. R. Agg, C. E., Professor of Highway Engineering, Iowa State College. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. vii + 432; 116 illustrations. $3 net.

Professor Blanchard is well known to the highway-engineering fraternity as co-author with Henry B. Drowne of the "Textbook on Highway Engineering," which was reviewed in *Engineering News*, Nov. 13, 1913. The book before us is of much the same character as regards make-up and illustrations. It has been written especially to meet the needs of engineering students. Nevertheless, it is a book of 450 pages and 202 illustrations, as compared with 750 pages of the "Textbook."

Some of the material is identical with that in the larger text, which was highly commended by Samuel Whinery in the review referred to above, but except for the first chapter, on the history of road building, and extracts here and there, the text appears to be entirely rewritten. The practice of taking copious verbatim quotations from the proceedings of road conventions and engineering societies has been followed, as in the "Textbook on Highway Engineering." While the smaller book has been in a large measure made by condensing or "boiling down" the larger, chapter by chapter, there is much new and later material added, and the chapter arrangement has been changed a trifle.

A page by page comparison of the two books leads to the conclusion that excellent judgment has been used in selecting the material "with a view to emphasizing the fundamental principles" and omitting such material as "is not considered essential to a broad knowledge of the science of highway engineering"—the expressed intention of the author. This has been done without limiting the scope of the larger book, which includes besides pavement construction much material on street cleaning, curb and gutter construction, etc. Practically all the illustrations are new. The new "Elements" should prove an excellent college textbook.

The first edition of the "Highway Engineers' Handbook," reviewed in *Engineering News*, Jan. 16, 1913, by A. W. Dean, Chief Engineer of the Massachusetts State Highway Commission, has become pretty well known to the profession. The preface of the second edition, recently off the press, states that the book has been revised "by bringing the material on top courses up to date and by adding considerable data on tests, designs, costs, maintenance and specifications." About 100 pages of new material have been added.

The character of the book has not been changed, and the criticism of Mr. Dean—that the data cited were largely local—still holds. But perhaps this is in a large measure unavoidable. The tables and data are of unquestioned value, but the expediency of combining these with general information and expert opinions based on local experience may well be questioned. It is quite impossible to keep such opinions up to date.

For the prime purpose for which "The American Road" is written, "to assist in forming an enlightened public opinion by presenting simple facts which underlie and are essential to sound practice in roadwork, and to promote an understanding of and coöperation with the movement for economic road building," the book seems to answer very well. It deals largely with the improvement of plain dirt roads, emphasizes the necessity for the best engineering talent available and gives sound advice on financing road improvement.

There are chapters on road administration, convicts and roadwork, earth-road construction, cost accounting and earthwork, earth-road maintenance, waterways, bridges, road finance, stone roads, gravel roads, sand-clay roads, road building with oils, and needed legislation. The author has constantly before him the problems of his own state of Oklahoma, which are similar to those of the other prairie agricultural states, and his book is well worth the attention of all highway engineers who have to meet these problems. It contains many homely truths that cannot have too wide a circulation or make too deep an impression.

Professor Agg's book is the most recent contribution to college textbooks on road construction, and it will be found a useful one. The successful experience of the Iowa State Highway Department in the construction and maintenance of earth and gravel roads and experience with an efficient system of state, county and township highway administration have furnished the author with splendid material and inspiration for these phases of road building.

On pavements he has drawn largely from practice as expounded at the various road and engineering conventions, city specifications, etc. The value of this material, as of any other data similarly compiled, depends on the extent of the compiler's acquaintance with current literature and on the judgment and skill used in selecting, abstracting and digesting the material available. Professor Agg's citations and examples leave one open to some doubt on these points.

The contents, cited in order, are: The development of highway systems, surveys and plans, design of rural highways, construction and maintenance of earth roads, testing nonbituminous materials, sand-clay roads, gravel roads, waterbound macadam pavements, concrete, vitrified brick, wood-block, stone-block, bituminous pavements, dust layers and bituminous carpets, penetration and mixed macadam pavements, sheet asphalt and asphaltic concrete, selection of class of pavement, design of pavements and tests of bituminous materials.

The book gives a concise treatment of the subjects mentioned, but its value to practicing engineers is limited for lack of more complete bibliographical data and the apparent limited sources from which the material is drawn. This is a real defect in a textbook on this particular engineering practice, which perhaps more than any other is based on individual experience, judgment and opinion.

In conclusion, in view of the rapidly increasing amount of road-building literature, the memory of highway engineers may be recalled to the very excellent book called "American Highways," written by the late N. S. Shaler, Dean of Lawrence Scientific School, Harvard University, in 1896. While written for popular consumption at a time before modern road building had commenced, it contains the soundest exposition of the principles underlying all road-improvement work that has yet appeared, and it is written in language that is a pleasure to read.

Some New Hydraulic Formulas and Tables

REVIEWED BY ROBERT E. HORTON*

HYDRAULIC FLOW REVIEWED: A Book of Reference of Standard Experiments on Pipes, Channels, Notches, Weirs and Circular Orifices, Together with New Formulas relating Thereto—By Alfred A. Barnes, A. C. G. I. New York: Spon & Chamberlain. Cloth; 6x10 in.; pp. 158; Illustrated with frontispiece and 2 folding plates. $4.50.

The author admits that several existing formulas for flow of water in pipes and channels are reasonably correct for some portion of the range covered by experiments. The purpose of his book is to show that a general formula of the type

$$v = CR^m S^n$$

or, in the author's notation,

$$v = Km^\alpha i^\beta$$

applies to the full range of experimental data for each class of conduit surface. The author goes farther and attempts to show that the same form of expression applies to weirs, both of the V-notch form and with level crest, both contracted and suppressed, and to orifices.

As a foundation for his deductions the author presents a table of results of 3,162 experiments on flow in pipes, flumes, canals and natural river channels, which he claims "form the most complete lists that have so far been compiled." The author hints that this table may be the most valuable part of the book. A short list of authorities consulted and cited is given. Neither in this nor in the table of experimental data does there appear any mention of American experiments reported during the past eight or ten years. This omission detracts materially from the value of the table, since many recent data on flow in brass and wrought-iron pipes, flumes, wood-stave and concrete pipes, and over weirs, are thereby ignored. There is no evidence that the author is familiar with other researches very similar to his review, or re-review—for example, those of Louis Schmeer and William H. Echols.

A most interesting feature of the book is the method of logarithmic plotting of experimental data developed for determining the constants K, α and β. By this system it is claimed that the experimental data when plotted depart from straight lines only to the extent of the accidental errors of observation. Furthermore, in this system the constants K, α and β for the full range of values of hydraulic radius and slope can be determined from four, or even three, sets of experimental determinations of v, R and S.

Since the same data have been repeatedly used in deducing other flow formulas, the merit of the author's formulas rests mainly on the superiority of this method of analysis of the experimental data. Those having occasion to make or analyze flow experiments will do well to become familiar with this method. The author finds that for a given class of friction surface the coefficient K and exponents α and β are constant. Others have reached the same conclusion. The fact is that the present-day tendency in hydraulics and hydrology is to abandon the older and simpler rules and methods in favor of more elaborate methods made necessary to meet modern requirements as to accuracy.

The author's formulas differ from other so-called exponential formulas, however, owing to the fact that instead of having constant exponents for R and S for all classes of friction surfaces, but with different coefficients for each class, the coefficient and exponents in his formulas, while constant for a given class, are different for each class of friction surface. The author presents 16 flow formulas for as many schedules of friction surfaces, varying from glass pipes to natural and artificial channels and canals in earth. He has computed by his formulas the calculated value of v for each of the 3,162 experiments listed, and the agreement with observed values on the whole is exceedingly good.

His method of plotting experimental data throws new light on certain existing formulas. He shows graphically that, granting that an expression of the form $v = CR^m S^n$ can fit the experiments correctly, then the Bazin formula is very nearly correct within the common range of experiments, but gives too small values of v outside the experimental range.

The author answers in a very satisfactory manner the question raised by Kutter himself, and on which criticisms of the Kutter formula are often based, as to why C is independent of the slope for $R = 1$ meter. Furthermore, he shows the Humphreys and Abbot experiments to be consistent with the so-called exponential formula. The use of these experiments in the derivation of the Kutter formula has often been subject to criticism. The author very properly hints that it is a misnomer to call an expression of the form $v = CR^m S^n$ an exponential formula, since the exponents are not the independent

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variables in the ordinary sense. It is not claimed that the coefficients in the author's formulas are absolutely final or that the formulas apply below the critical velocity.

The author specially tests his formula for velocities and slopes much above the ordinary range and claims that they hold true for all possible slopes and velocities above a minimum of about 1 ft. per sec. The author takes the position that the common theoretical forms of expression for flow in pipes and orifices or over weirs should be disregarded until their adaptability is confirmed by experiment. It seems, however, like straining too far to use the form of expression $Q = KM^{\alpha}H^{\beta}$ for circular orifices, since it is known that the discharge coefficient varies with the diameter of the orifice; and if K is replaced by $C = 0.60\ D^{-0.015}$, the author's formula reduces to identity with the ordinary theoretical form of expression. Thus the theoretical expression fits as well as the author's empirical formula, and instead of the discharge varying with the wetted perimeter as a main independent variable, as the author contends, the coefficient varies with the perimeter and with it the discharge, but in a very minor degree. A similar criticism might be made of the author's deduction with regard to weirs.

An American Huette

MECHANICAL ENGINEERS' HANDBOOK: Based on the Hütte and Prepared by a Staff of Specialists—Lionel S. Marks, Editor-in-Chief, Professor of Mechanical Engineering, Harvard University and Massachusetts Institute of Technology. New York: McGraw-Hill Book Co. Flexible leather; 4x7 in.; pp. xxiii + 1,779; illustrated. $5 net.

The few engineers around the country who have known that 50 contributors, and some 30 other specialists aiding by criticism and suggestion, were working on an American handbook to be a counterpart of the famous Hütte, will be interested in the volume which has finally appeared. The list of contributors makes an impressive array of names well known in teaching or commercial practice. The handbook is based only on the mechanical engineering section of the Akademischer Verein Hütte and only the sections on "Friction" and "Hydraulic Turbines" follow the original at all closely. The chapters on "Heat" and the "Mechanics of Materials" follow the German book in a general way, and the rest of the volume seems to have depended on the original only for the benefit of the German publishers' experience in regard to scope and handling of topics. Comparatively few German data are used. All things considered, this book may be regarded as the fullest development of the cooperative handbook. The impression made by the book as a whole is very pleasing, to which effect the neatness of illustration materially contributes.

There is little need of dwelling at length on the mathematical section, but the insertion of hyperbolic functions and log tables perhaps should be noted. The mathematical text is unusually extended for a handbook, there being particularly handy matter on applications of geometry, on determinants, complex quantities, useful curves (analytical geometry), differential equations, and graphical representation of equations involving two to four variables.

The theoretical elements of mechanics, while condensed, might be called extended for a mechanical engineers' pocketbook, judging by old standards—especially as regards kinematics of rigid bodies and stresses in structures. The treatment of friction, especially of machine elements, is ample.

The hydraulics chapter contents itself with a brief review of the theory of hydrostatics and hydrokinetics—plus data on flow through orifices, nozzles, pipes and channels and over dams and weirs—and with descriptions of pressure, velocity and level gages. Here are introduced condensed conversion tables, consisting of two parallel scales separated by a single reference axis. There is not given as wide a range of Kutter's coefficients for flow as is available—as illustrated by the tables collected by Horton.

A considerable part of the section on heat is devoted to theory—general thermodynamics and transmission phenomena, flow of gases, fuel combustion, etc.—but there is an immense compilation of data on specific expansions, densities, heats, melting and freezing points, conductivities, radiation constants, properties of steam, gases and vapor mixtures.

About a third of the book is devoted to what might be called the raw materials of engineering, although this part is split up into sections and chapters bearing various titles. Herein are included the summaries of textbook matter on the production, handling and strength of materials and of structure and machine elements—in contrast with the parts presenting the performance of complete plants, plant units or structures (or the physical characteristics of the output from plants or plant units), which may be regarded as forming another distinct part of this book, although also broken up into sections and chapters. Under "Strength of Materials" are given the specific constants of various materials, the definitions and theory of stresses and deformations and the familiar properties of beams, sections, springs, columns, etc. The theory of reinforced-concrete design is found here (and there is a complementary section on reinforced-concrete construction later, under "Building Construction and Equipment"). Another section, entitled "Materials of Engineering," opens with a tabulation of chemical elements and weights of most common substances. The different iron and steel processes and products are described and accepted specifications and test figures given for the latter. The whole nonferrous-metal world is similarly covered. One chapter reviews present knowledge on corrosion of metals, particularly iron; closely related is a following chapter on protective coatings—in which various kinds of paints, varnishes, etc., are described, with notes on their proper application. A chapter on cement, mortar and concrete tells what these things are, what they are used for and how they are affected. Similar is the make-up of the chapters on wood, abrasives, adhesives and all the nonmetallic materials, including fuels. What has so far been noted fills 800 of the 1,780 odd pages of text.

In that part which may be said to deal more or less completely with power generation or utilization there comes first a section on "Machine Elements," with descriptions of fundamental mechanisms and data on such machine or plant elements as screws, riveted joints, keys, shafts, couplings, commercial bearings, gears, belts, engine parts, pipes and fittings, valves, hose, rope and nails. Then the book switches to a section on "Power Generation," which opens with notes on animal and wind power and gives data on design, on construction and operation costs, on best performances, etc., of boilers, gas producers, chimneys, engines, steam and hydraulic turbines. Much the same sort of treatment is given to hoisting and conveying apparatus—including therein excavating machin-

ery—and to transport equipment—automobile, railway, marine and aërial.

Some readers might expect that the section on "Machine-Shop Practice" would immediately follow—since it describes foundry and forging machines, machine tools, welding equipment, gives data on best metal-cutting speeds and power requirements, reviews modern shop management and accounting, and covers pumps, compressors and fans in the same way as noted for power-plant equipment. But there is an interjected section on "Building Construction and Equipment," the first part of which is complementary to some of the chapters on materials—in so far as it gives proper foundation loads, proper use of masonry, timber and reinforced concrete, roof loads, design of frames, etc. This building section gives more than half of its space to planning industrial buildings, defining good heating, ventilation, illumination, accident prevention and fire protection.

Electrical engineering comes in with a section in which are found a brief dissertation on the theory of magnetic and electric circuits, data on electrical properties of certain materials, descriptions of distribution systems, instruments, batteries, dynamo-electric machinery, transformers, and notes on the uses and costs of such apparatus.

The final section of this notable compendium, entitled "Engineering Measurements," first covers laboratory work in temperature, pressure, speed, weight, area, power, fluid-flow and gas-composition determinations. It has the briefest possible review of field surveying and leveling. There are placed here also some miscellaneous topics not closely related to the other parts already reviewed—refrigeration, patent law, first aid, optics, and the American Society of Mechanical Engineers' various test codes.

In what has been thus ably presented by the many authors of this handbook it would seem as though the needs of mechanical engineers had been met in about every possible way one could forecast. The real test of every such handbook lies in its daily use by the thousands of practitioners who will buy it. Only when such results are compiled can a critique—a real review—be written or definite comparison made with the older handbooks which have apparently a greater accumulation of time-honored performance records.

Panama Mosquito Engineering

MOSQUITO CONTROL IN PANAMA: The Eradication of Malaria and Yellow Fever in Cuba and Panama—By Joseph A. LePrince, C.E., A.M., Chief Sanitary Inspector, Isthmian Canal Commission, 1904-1914, and A. J. Orenstein, M.D., Assistant Chief Sanitary Inspector, Isthmian Canal Commission. With an Introduction by L. O. Howard, LL.D., Entomologist and Chief, Bureau of Entomology, United States Department of Agriculture. New York: G. P. Putnam's Sons. Cloth; 6x9 in.; pp. xvii + 335; 100 illustrations. $2.50 net.

The extent to which mosquito control on a large scale is a series of engineering problems is well illustrated by this book, the senior author of which is an engineer with long experience under General Gorgas in mosquito-reduction work at Havana and on the Isthmus of Panama.

Part I, which fills two-thirds of the volume, deals with the campaign against malaria. After briefly sketching anti-malarial knowledge prior to 1904 and also the Havana campaign, the book takes up meteorological and topographical conditions on the Isthmus. Attention is called to the effect of topographical changes on the *Anopheles*, or malaria-spreading mosquito—a matter of prime importance to engineers engaged in construction work affecting surface water conditions in any part of the world where mosquitoes abound. Next come discussions of *Anopheles* as regards species, propagation and harboring areas, food, flight and attraction to human beings and their habitations, followed by descriptions of methods of attack on propagation areas by filling, drainage, oiling, larvacides, natural enemies, cleaning bodies of water of vegetation and débris, and cleaning jungles. Protection of inmates of houses by screening mosquitoes out and destroying those within is given a chapter. Part I closes with a summing up of anti-malaria results.

Part II, on the campaign against yellow fever by controlling the species of mosquitoes known as *Aides calopus*, follows the same general lines as Part I, but with much less detail.

Points of the book that have great interest for all readers and at the same time demand close attention by engineers and others working in mosquito-infested areas are the vagaries of mosquitoes as regards breeding places and other habits bearing on their control, and the great care that must be given to a variety of engineering and allied matters, large and small.

An attractive feature of the volume is its halftone engravings. Equally attractive and very useful to many engineers will be the line drawings showing such details as concrete linings for various kinds of ditches splash; walls at ditch junctions to prevent water from breaking over and forming small pools; eave-troughs, door screens, mosquito traps and various devices for studying the flight of mosquitoes.

Railway Sociology

PRINCIPLES OF RAILROAD TRANSPORTATION—By Emory R. Johnson, Ph.D., Sc.D., Professor of Transportation and Commerce, University of Pennsylvania; author of "Ocean and Inland Water Transportation," "Elements of Transportation," etc., and Thurman W. Van Metre, A.M., Ph.D., Instructor in Transportation, School of Business of Columbia Universtiy. New York: D. Appleton & Co. [Appleton's Railway Series.] Cloth; 6x9 in.; pp. xix + 619; illustrated. $2.50 net.

The last edition of Professor Johnson's treatise on "American Railway Transportation" was published in 1908. With the assistance of Professor Van Metre of Columbia University, he has rewritten and enlarged the former work and it now appears under the title above quoted. The present volume contains probably twice as much matter as the old one, and the increase of price from $1.50 to $5 is rather a significant illustration of the economic changes that have taken place in the eight years.

The present volume is divided into four parts. The first takes up the history of the American railroad system and gives an elementary description of its physical construction, track, rolling stock, etc., with chapters on the financial and legal side of railway operations. Part II deals with the railroad service, classified under freight service, passenger service, express and mail service. A chapter on railway accounts and statistics is also included. Part III is entitled "The Railroads and the Public," and there is included under this head the relation of railways to each other, railway competition and monopoly, and railway freight rates and passenger fares. Part IV takes up the relation between the railways and the Government, and covers not only the United States, but Great Britain, Germany, Italy and France. Other chapters in this section give the history of state and Federal regulation in this country, and the final chapter discusses the general problem of Government ownership and Government regulation in the United States.

A useful feature of the book is a brief bibliography appended to each chapter. As will be gathered from the foregoing brief review of the contents of the volume, the book is chiefly devoted to the social, political and economic relations of the railway rather than to the physical features of its construction and operation. It is on these public relations of the railways, however, that attention is concentrated at the present day. Thinking men who desire to ascertain fundamental facts in order to form intelligent opinions on questions relating to the railway will find safe guidance in this excellent treatise.

Model Engineering Report on Sacramento Water-Supply

REVIEWED BY CALEB MILLS SAVILLE*

A REPORT UPON POSSIBLE SOURCES OF WATER-SUPPLY FOR THE CITY OF SACRAMENTO, CALIFORNIA—By Charles Gilman Hyde, George H. Wilhelm, Consulting Engineers; Frank C. Miller, City Engineer. Sacramento, Calif.: City Commission. Paper; 6x9 in.; pp. 660; illustrated.

Not since the illuminating and instructive reports of John R. Freeman on the water-supplies of New York and San Francisco has there appeared such a voluminous and well-presented water-supply report as the one submitted last April to the City of Sacramento and just made public in printed form. The mass of detail applicable to both local and general water-supply conditions is so considerable that it would be impracticable to attempt a detailed review. The general character and methods of handling the subject, therefore, can only be touched upon at this time. The report is carefully and logically assembled, maps well drawn and excellently chosen to illustrate the text, and tables and diagrams so prepared and placed as to set forth clearly the ideas of the authors.

Preceding the text is a very complete table of contents filling 30 pages. In the back of the book are two appendices, one of 11 pages giving an "interpretation of chemical and biological analysis of water," the other a "table of particular references" applicable to the subjects treated in the body of the report. The index in the back of the volume occupies 34 pages and bears evidence of very careful compilation.

The text is divided into five principal parts: I. Fundamental Considerations Relating to the Water-Supply Problem in Sacramento. II. A Filtered and Disinfected Water-Supply from the Sacramento River. III. A Supply from the Ground in the Vicinity of Sacramento. IV. A Supply from the Sierra Nevada Mountains. V. Comparison of Sources and Projects and Recommendations.

The table of contents in itself is of considerable educational importance as a guide for comprehensive investigations and reports of this character. The subheads are well chosen, each principal part is closed with a summary and conclusions, and the report is completed with a comparison of the sources and projects.

The letter of transmittal of 4½ pages states very concisely the results of the investigation and closes in a dignified manner without any of the fulsome balderdash so often met with in public reports. The writers of this report are undoubtedly men of decision, and Sacramento is to be congratulated in having intrusted her investigation to men who not only were capable of making exhaustive inquiry into the problems of public water-supply, but having arrived at a definite conclusion, had the courage of their convictions to state in no uncertain terms:

> If the works are built in accordance with the general project outlined and described in our report, and if the works are properly operated, the writers do not hesitate to guarantee that the water-supply furnished from this source will be brilliantly clear, colorless, satisfactorily soft and hygienically most gratifying and safe.

Part V, which is a statement of "Comparison of Sources and Projects," is equally concise and to the point. Containing only 17 pages of text and tables, it reviews the entire subject fully and completely, apparently omitting no important point, but giving a brief comparison of the principal features of all the sources investigated. The citizen who has only ordinary interest in this matter will find in the letter of transmittal and in the comparison of sources and projects all that he needs for forming an opinion. The 568 pages contained between these two statements are crammed full of water-supply data—results and conclusions—necessary for a proper study of the subject, but oftentimes entirely omitted from a report. Like the other portions of the book, this matter is so clearly and compactly stated that it not only forms a most valuable record for the Sacramento Water Department, but gives to that citizen who is sufficiently interested to read it through a comprehensive knowledge of the most important of the city's utilities.

The purpose of the report is excellently carried out. That is, to place clearly and concisely before the public of Sacramento the whole matter of the additional public water-supply—stripped of technicalities, but complete in reasoning and deductions.

Such reports as those of New York, San Francisco and Sacramento, if interpreted by competent teachers, are the best textbooks that can be used in engineering schools. They embody the latest thought of engineering specialists, while the contents of the stereotyped textbook, except for fundamentals, are often antiquated before their appearance in print.

Safety Engineering

PRACTICAL SAFETY METHODS AND DEVICES: Manufacturing and Engineering—By George Alvin Cowee, E. M., S. B., Manager, Bureau of Safety, Utica Mutual Compensation Insurance Corporation. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. ix + 434; 128 illustrations. $3 net.

In the introductory chapter to this book the author remarks that safety engineering has become a well-established profession, although it is a comparatively new field of endeavor. He declares that industrial accidents in the United States cause annually the loss of 35,000 lives and about 350,000 serious injuries, while 2,000,000 persons suffer minor accidents sufficient to cause loss of time. These figures challenge attention and fully justify the nation-wide movement toward accident prevention which has had such great development during the last 15 years.

That the work of accident prevention is justified not alone from humanitarian motives, but as a matter of business economy, is proved by the experience of the United States Steel Corporation. Its subsidiary companies have spent in the neighborhood of $5,000,000 during the last eight years in the installation of safety devices and accident-prevention methods. The results of this work have been to reduce the accident rate about

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40% during the past five years. In the past three years, after adding to the expenses due to accidents all the amounts expended on safety work, the total still shows a reduction of over 35% compared with the accident expenses of earlier years. This reduction has taken place notwithstanding the fact that in recent years the rate of compensation to injured workmen has been materially increased.

Within the limits of a single volume the size of the one under consideration it is of course impossible to cover more than a small part of the safety methods and appliances in use in special industries. The author devotes, for example, one chapter of about 25 pages to the matter of safety on steam and electric railroads; but to cover completely all the features of safety work in the different departments of railway service, such as signaling, braking, crossing-guards, rules for trainmen, rules for shippers, etc., would take a whole book or several books of the size of this one.

What the author has aimed to do in this book is to cover the most important features and principles of safety-engineering work as carried on in different industries.

Beginning with such general matters as safety instruction to employees through the organization of safety committees, use of danger signs, guarding moving machinery, education and discipline for safety, the author proceeds with a chapter on "Buildings and Fire Hazard." He makes no mention here of the admirable system of safeguarding the occupants of multi-story factory and loft buildings, hospitals, etc., by carrying a fireproof division wall through the building from foundation to roof, with an escape doorway on each floor, so that in case a fire occurs at any point the occupants can quickly escape through the fire-door to the other side of the fire wall.

The chapter on "Boilers" is one of the longest in the book, but we find no mention in it of the American Society of Mechanical Engineers' standard code for boiler construction.

In the chapter on "Explosives" a long quotation is made from the Pennsylvania R.R. rules for handling explosives. These rules went into effect on the Pennsylvania R.R. in 1899. There is no mention, however, of the work of the Federal bureau that has for many years had supervision of all handling of explosives in interstate traffic. In addition to the chapters on safety work proper there are other chapters on sanitation; heating, lighting and ventilating; welfare work; occupational diseases; first aid to the injured; etc.

The book is printed in large type on a heavy coated paper with wide margins and a profuse use of halftone illustrations. The same matter could easily have been presented in a book of less than half the weight, a saving that would have been appreciated by engineers who have to carry their libraries with them in moving from place to place.

Worthy Official Description of Los Angeles Aqueduct

FINAL REPORT ON THE CONSTRUCTION OF THE LOS ANGELES AQUEDUCT, with Introductory Historical Sketch. Los Angeles, Calif.: Department of Public Service. Cloth; 8x11 in.; pp. 319; illustrated with maps, drawings and photographs. $1.95.

The unique plan, for an American city, of putting on sale the report on the construction of the Los Angeles Aqueduct, announced in these columns some weeks ago, resulted in such an unexpected and continuing demand that it was decided to print an edition sufficient to fill all probable orders received after the expiration of the original time limit on July 15. The report is now available to all who desire to pay a small sum for a concisely written and handsomely illustrated account of this great engineering enterprise. Very appropriately, the report has as a frontispiece a portrait of William Mulholland, chief engineer of the Los Angeles Aqueduct and for many years prior to that in charge of the Los Angeles water-works under early private and later municipal ownership.

After some 40 pages on the history of the project, including an account of investigations of other sources of supply, the report takes up the Owens River drainage area, the quality of the water and the Federal aid extended to the city in securing the necessary water rights on the public domain. There follows a general description of the aqueduct. Then comes an account of the methods of transportation that played so important a part in construction. The municipally owned cement mill and tufa plant are very properly featured in the report.

These subjects disposed of, there follow in order descriptions of the various dams, tunnels, conduits and siphons, with particular reference to their construction. The large power development is considered next.

The organization scheme that made possible the successful carrying out of this great work is described, and there is also a brief outline of the cost-keeping and accounting methods employed, a few pages on finances and two or three pages of very interesting figures comparing the estimated and final cost of the work. Appendices take up in some detail the water resources of Owens Valley and also the sanitary quality of the aqueduct water. The second of the appendices just named recounts what it is to be hoped will be the last attack made by the enemies of the aqueduct project. The outcome of this attack on the quality of the water, as any sensible person might expect, was the utter discomfiture of the assailants.

Besides the many handsome halftone plates and a few drawings in the body of the book, a pocket at the back contains some two dozen maps, profiles and other drawings.

The report is notable for containing so little that is of merely local interest—if indeed it contains anything of the sort. It will undoubtedly be given a place in every library, public or private, that welcomes important contributions to the literature of hydraulic and water-works engineering and interesting and suggestive records of vast municipal undertakings. That the Los Angeles Aqueduct, 250 mi. long, with an unprecedented number and variety of tunnels, siphons, open and covered stretches of canals, and with its dams, reservoirs, hydro-electric plant and vast irrigation system, falls in both categories no one will deny.

Some phenomena of the plastic flow of moist clay were studied at the United States Bureau of Standards recently, and are discussed by E. C. Bingham in a pamphlet just issued as Scientific Papers, No. 278, "An Investigation of the Laws of Plastic Flow." Measurements of flow through capillary tubes under various pressures were made, using different percentages of water. The quantity of material flowing through in a given time was found to be proportional to the pressure less a value

that the author calls the friction. Pressures less than the friction did not produce flow, except that with some mixtures there was a slight flow attributed to seepage of water through the pore space. The pamphlet should be read by all who have to deal with plastic flow of clays.

Statistics of the amount and value of sand and gravel produced for various purposes in the United States in 1915 and a short discussion of the differences in weight of a cubic yard of gravel, as reported in various states, fill a 12-page reprint of "Mineral Resources of the United States, 1915." (Washington: United States Geological Survey.) The text is by R. W. Stone.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ANNUAL REPORT OF THE BOARD OF PUBLIC UTILITY COMMISSIONERS FOR THE STATE OF NEW JERSEY FOR 1915—Trenton, N. J.: The Board. Cloth; 6x9 in.; pp. 405.

APPLIED ELECTRICITY FOR PRACTICAL MEN—By Arthur J. Rowland, Professor of Electrical Engineering at Drexel Institute. New York: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. xiv + 375; 323 illustrations. $2.

CENTRIFUGAL PUMPS AND SUCTION DREDGERS—By E. W. Sargeant. Philadelphia: J. B. Lippincott Co. Cloth; 6x9 in.; pp. viii + 188; 160 illustrations, including 14 folding plates. $3.25.

THE CHEMISTRY AND TECHNOLOGY OF PAINTS—By Maximilan Toch, author of "Materials for Permanent Painting." New York: D. Van Nostrand Co. Second revised edition. Cloth; 6x9 in.; pp. 366; 83 photomicrographic plates and other illustrations. $4 net.

CONCRETE LININGS FOR IRRIGATION CANALS—Published by the Portland Cement Association, 111 West Washington St., Chicago, Ill. Paper; 6x9 in.; pp. 15. Free on request. The advantages of concrete lining are discussed and various examples are presented.

ELECTRICAL ENGINEERING, ADVANCED COURSE—By Ernst Julius Berg, Sc. D., Professor of Electrical Engineering, Union College; author of "Electrical Engineering, First Course." New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. viii + 332; 163 illustrations. $3.50 net.

ELECTRIC UNITS AND STANDARDS—Washington, D. C.: United States Bureau of Standards. Circular No. 60. Paper; 7x10 in.; pp. 68. 15c. a copy, from Superintendent of Documents, Government Printing Office, Washington, D. C.

ENGINEERING FEATURES OF THE WAIAHOLE WATER PROJECT OF THE WAIAHOLE WATER CO. (Island of Oahu, Territory of Hawaii)—By Charles H. Kluegel, M. Am. Soc. C. E. Honolulu, T. H.: Hawaiian Engineering Association. Press Bulletin No. 55. Paper; 6x9 in.; pp. 24, illustrated.

EXAMPLES IN ALTERNATING CURRENTS, VOL. I—By F. E. Austin, B. S., E. E., author of "How To Make a Transformer for Low Pressures," etc. Second edition, with additions for students and engineers. Hanover, N. H.: The Author. Leather; 5x8 in.; pp. 223; 70 illustrations. $1.10 postpaid.

THE FLOTATION PROCESS—By Herbert A. Megraw, M. Am. Inst. M. E., Member of the Editorial Staff of the "Engineering and Mining Journal," author of "Practical Data for the Cyanide Plant" and "Details of Cyanide Practice." New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. ix + 249; 48 illustrations. $2.50 net.

GOVERNMENT OF THE CITY OF ROCHESTER, N. Y.: General Survey, Critical Appraisal and Constructive Suggestions—Prepared for the Rochester Bureau of Municipal Research by the New York Bureau of Municipal Research (261 Broadway, New York City). Paper; 6x9 in.; pp. 546; illustrated.

A GRAPHICAL METHOD FOR THE CORRECTION OF STEEL TAPES—By Walter Scott Weeks. Berkeley, Calif.: University of California. Engineering Publication No. 9. Paper; 7x10 in.; pp. 261-268.

HANDBOOK OF MACHINE-SHOP ELECTRICITY—By C. E Clewell, Assistant Professor of Electrical Engineering, University of Pennsylvania. Leather; 4x7 in.; pp. xi + 461: 61 illustrations. $3.

HEALTH CONSERVATION AT STEEL MILLS—By J. A. Watkins, Passed Assistant Surgeon, United States Public Health Service. Washington, D. C.: United States Bureau of Mines. Technical Paper 102. Paper; 6x9 in.; pp. 36. 5c. a copy from the Superintendent of Documents, Washington, D. C.

HOW TO MAKE LOW-PRESSURE TRANSFORMERS—By F. E. Austin. Third edition, with additions. Hanover, N. H.: The Author. Linen; 5x7 in.; pp. 22; 16 illustrations. 40c. The size of this booklet has been doubled in the present edition.

A HYPOTHESIS REGARDING THE USE OF THE DIVINING-ROD IN LOCATING UNDERGROUND WATER—By Carl B. Andrews. Honolulu, T. H.: Hawaiian Engineering Association. Press Bulletin No. 56. Paper; 6x9 in.; pp. 16; illustrated.
A compilation from the "writings of M. Henri Mager, the Encyclopedia Britannica and other books." The author concludes that a "sensitive mechanical device" is essential to satisfactory water finding, which he believes "is now to be considered as a process explainable by physics, in regard to which we should not despair of eventually obtaining a complete knowledge."

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MINERAL RESOURCES OF ALASKA: Report on Progress of Investigations in 1915—By Alfred H. Brooks and Others. Washington, D. C.: United States Geological Survey. Bulletin 642. Paper; 6x9 in.; pp. 279; illustrated.

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THE PANAMA CANAL AND COMMERCE—By Emory R. Johnson, Ph.D., Sc. D., Professor of Transportation and Commerce, University of Pennsylvania; Member Isthmian Canal Commission, 1899-1904; Special Commissioner of Panama Canal Traffic and Tolls, 1911-1913. New York: D. Appleton & Co. Cloth; 5x8 in.; pp. 296; illustrated. $2 net.

PRINCIPLES OF ALTERNATING-CURRENT MACHINERY—By Ralph R. Lawrence, M. Am. Inst. E. E., Associate Professor of Electrical Engineering of the Massachusetts Institute of Technology and Harvard University. New York: McGraw-Hill Book Co. [Electrical Engineering Texts.] Cloth; 6x9 in.; pp. xvii + 614; 273 illustrations. $4.50 net.

PROCEEDINGS OF THE BROOKLYN ENGINEERS' CLUB FOR 1915: Constitution and By-Laws and Annual Report of the Board of Directors—Brooklyn, N. Y.: Office of the Secretary, 117 Remsen St. Cloth; 6x9 in.; pp. 274; illustrated. $2.

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PROGRESS REPORT OF THE MANITOBA HYDROMETRIC SURVEY FOR 1912-13-14—Ottawa, Canada: Dominion Water-Power Branch. Water Resources Paper No. 4. Paper; 7x10 in.; pp. 287; illustrated.

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REPORTS OF THE ALASKAN ENGINEERING COMMISSION FOR THE PERIOD FROM MAR. 12, 1914, TO DEC. 31, 1915—Washington, D. C.: House of Representatives. Document 610, Part 2. Paper; 6x9 in.; pp. 210; illustrated and 18 maps in portfolio.

REPORT ON PIPE-LINE TRANSPORTATION OF PETROLEUM—Washington, D. C.: Federal Trade Commission. Paper; 6x9 in.; pp. 467; illustrated.

THE SANITARY PRIVY—St. Paul, Minn.: Minnesota State Board of Health. Paper; 6x9 in.; pp. 15; illustrated.

STRESSES IN STRUCTURES—By A. H. Heller, C. E., late Professor of Structural Engineering, Ohio State University. Revised by Clyde T. Morris, M. Am. Soc. C. E., Professor of Structural Engineering, Ohio State University. Third edition. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. xviii + 374; 230 illustrations. $2.75 net.

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WATER-SUPPLY PAPERS, UNITED STATES GEOLOGICAL SURVEY—Washington, D. C. Paper; 6x9 in. Copies may be procured from the Superintendent of Documents, Washington, D. C., for the prices stated below.
- No. 360. Surface Water-Supply of the United States, 1913; Part X, The Great Basin. Pp. 293. 30c.
- No. 384, Surface Water-Supply of the United States, 1914; Part IV, St. Lawrence River Basin. Pp. 128. 10c.
- No. 387, Surface Water-Supply of the United States, 1914; Part VII, Lower Mississippi River Basin. Pp. 60. 5c.
- No. 393, Surface Water-Supply of the United States 1914; Part XII, North Pacific Drainage Basins. B. Snake River Basin. Pp. 248. 15c.

Notes from Field and Office

Sand-clay surfacing 15c. per lin. ft.—How one contractor erects transmission towers—Spanish influence in Texas surveying—Vicissitudes of a bridge built from a "picture"—Drills rough 113,000 sq. ft. of concrete floor—Breaking rock not attractive to the unemployed

Sand-Clay Street Surfacing from Sewer Trenches

By M'Kean Maffitt*

An excellent sand-clay surfacing for residence streets is being obtained at minimum cost in Florence, S. C. Trenching for sewers always opens up strata of clay. There is usually a covering of loamy clay or sand to a depth of 18 in. or 2 ft., under which is a stratum of good stiff clay of varying thickness.

Our method is as follows: We take a two-horse turn plow and go over the entire surface of the street, plowing

FIGS. 1 TO 3. BUILDING SAND-CLAY PAVEMENTS IN FLORENCE, S. C., WITH CLAY FROM SEWER TRENCH

up all the top soil. Then with drag scrapers all of the top soil is removed from one side of the street and piled on the opposite side.

In trenching, a negro with a mule and a rooter plow breaks up the clay in the ditch (see Fig. 1) so that the other laborers can shovel it out on the side of the street from which the top soil has been removed. The top soil is on the left and the clay on the right in Fig. 1.

After the pipe has been laid and bedded in clay, the top soil and spoil bank on the left (Fig. 1) are thrown into the ditch and puddled, leaving, where available, enough sand to go with the clay for surfacing the street. Where there is insufficient sand to go with the clay, it is hauled in from streets where there is an excess.

The sand is dumped to the outside of the clay pile and then shoveled over and mixed thoroughly with the clay as it is spread over the street (see Fig. 2). In this way we get about the proper amount of sand with the clay and get it thoroughly mixed. Fig. 3 shows the street after being surfaced, only a small amount of traffic having gone over it.

After a couple of rains and when the street has been dragged with a split-log drag several times, it will be level, smooth, practically waterproof and so hard that a good sharp pick will hardly make an impression on it.

On the last two blocks of street surfaced by the above method the cost of surfacing a 30-ft. width was about 15c. per lin.ft. of street. The exact cost has not been determined, as all the labor and cartage were charged to the sewer work and the final cost sheets have not yet been made out.

*Superintendent of Water and Sewers, Florence, S. C.

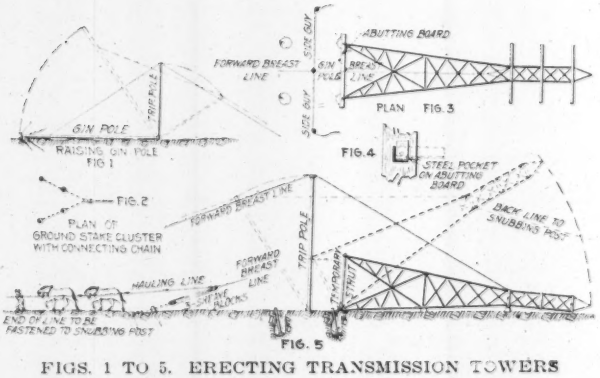
Erecting Steel Transmission Towers with Ginpole

By L. R. Allison*

Steel transmission towers of standard design and construction usually are assembled on the ground adjacent to the site and drawn up as a unit on the provided foundations. The use of a ginpole for the erection of built-up steel structures of this type affords particular advantages, not only facilitating installation operations in the field, but introducing an economy factor, under proper working conditions, of no mean importance.

To obtain the greatest efficiency in the erection phase of their extensive transmission-tower work, Milliken Brothers, Inc., New York, iron and steel contractors, have arranged a simple and effective plan of operation, using a ginpole for rapid and easy installation. The accompanying diagrams explain the method.

*170 Roseville Ave., Newark, N. J.



FIGS. 1 TO 5. ERECTING TRANSMISSION TOWERS

Fig. 1 shows the manner of raising the ginpole by means of a trip-pole. Fig. 2 is a diagram of ground-stake arrangement, showing a cluster of four stakes with connecting chain. Fig. 3 is a plan of an assembled tower ready for erection on four constructed footings; as will be noted, the breast line extending to the ginpole is attached to the tower at a level with the first crossarm. The detail drawing, Fig. 4, explains the steel pocket on the abutting board used in erecting the tower; this pocket is formed of steel angles with connecting clip bolted to the board, and forms a brace support for the lower legs of the transmission towers as it is drawn up in position.

Fig. 5 is a side elevation of the tower, and comprehensively illustrates the practical use of the ginpole for erection. A temporary strut is placed between the legs of the bottom section of the tower to brace it thoroughly during erection. As will be noted, a second position of the tower as it assumes the foundation and the corresponding ginpole movement are indicated; during the operation, the ginpole is sustained in an upright position by the guy wires.

This plan of transmission-tower erection has proved so efficient that representatives of the company are furnished with instructions similar to the diagrams here reproduced, in order to become familiar with the practical principles involved.

Land Surveying in Texas

By J. M. Howe*

Surveyors accustomed to sectionized lands will find themselves confronted by absolutely new problems when they attempt work in Texas. When the Republic of Texas was admitted to the Union as a state it retained its lands; therefore the United States system of sections and quarter-sections does not prevail. In order to do work in the state, some knowledge of the history of the land laws is essential.

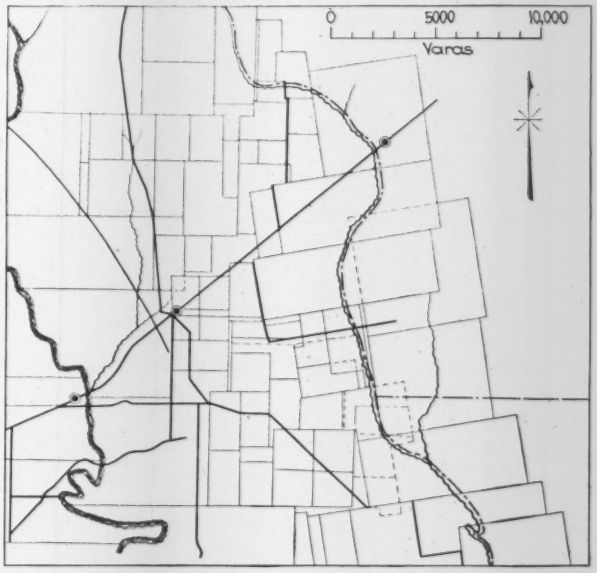
In the early settled portions of Texas there are large tracts of land granted by Spain to her colonists, and over a much greater area there are Mexican Republic grants. These Spanish and Mexican grants were usually made as *labors* and *sitios* or leagues and multiples or fractions thereof. A *labor* contains about 177 acres and a *sitio* 4,428 acres.

These units of area were derived from the basis of linear measurement, which was the *vara*, a square *labor* being 1,000 *varas* on a side and a square *sitio* 5,000 *varas*. The exact length of the *vara* seems to have been a little uncertain, but it has been fixed by statute in Texas at 33⅓ in. The usual method of conversion used by surveyors is to divide distances in *varas* by 0.36, there being 36 *varas* in 100 ft. Spanish and Mexican measures were continued by the Republic of Texas, though Texas as a state, while continuing the use of the *vara*, changed the basis of grants from the *labor* and *sitio* to the section of 640 acres.

Grants made under Spanish, Mexican and Texas Republic titles were located wherever vacant land was found, and with some restrictions as to frontage on streams, in whatever shape the grantee desired. The location work was done by surveyors sometimes using 10- or 20-*vara* chains, but frequently, especially during the colonization period just before and during the days of the Texas Republic, using Gunter's chains. The surveyors coming from the older states of the Union had Gunter's chains, which they cut down to a 20-*vara* length. Land at the time was worth from 10 to 25c. per acre, so it can readily be appreciated that the pioneer surveyors did not trouble themselves much about accuracy.

As the country settled up, it became necessary to fill in between the early large grants with section and quarter-section surveys. These had to abut and tie in to the older tracts. As the early work was often poorly done, with original corners obliterated or nowhere near their called-for places, there has resulted a mass of overlaps and vacancies that make much trouble.

The later filling-in surveys located by surveyors working from such recorded data as were available are frequently found, on making a more thorough investigation, to be based on erroneous conclusions as to the correct location of the older surveys. When the early survey can be established, even though it be excessive in area, and they frequently are, conflicting junior surveys must give way to the senior ones. In consequence, when making surveys at the present time, it is necessary to investigate the date of the original surveys to establish priority.



TYPICAL CONDITIONS OF TEXAS LAND SURVEYS

A majority of the earliest surveyors seem to have been of a liberal disposition, for it is seldom that old league lines are short on distance; excesses are the rule. Now, with the passing of time and the consequent obliteration of original corners, efforts are sometimes made to hold early surveys to their net call for distance. When this is done and can be sustained in court, it leaves vacant land which is subject to grant by the state just as any other part of the public domain.

Another fruitful source of trouble is course. Where is North is a question that is continually coming up, and it has a different answer on nearly every line run. No effort was apparently made by the early surveyors to locate true north, each one using the declination that suited his fancy. The result is that in counties where the true declination is, say, 8° E., lines will be found running on declination from 6½° to 10° and all recorded

*Of Howe & Wise, Consulting Engineers, Houston, Tex.

as North. Frequently a survey is fitted in between two earlier surveys, one of which was run with a declination of 7° and the other with 9°. The fitting-in survey will have its lines recorded as North and South in spite of the fact that the lines are not parallel by 2°. The only way to determine North in any particular case is to get out on the ground and retrace a line or two. Some of the experienced surveyors profess to be able to tell, with reasonable closeness, what the course and distance of certain surveys will be when they know the name of the original surveyor.

Owing to the many difficulties of establishing lines, only really hinted at above, a certain facetious judge, prominent for his knowledge of Texas land law, is said to have demanded as a qualification to testify as an expert surveyor in his court the ability to solve the Texas rectangle. He defined this as a rectangular parallelogram, no two sides of which are the same length and no angle of which is a right angle. Fortunately for the present generation of landowners, occupation and inclosing of the properties are settling most of these uncertainties.

County-Bridge Curiosities

In the county surveyor's office of a prosperous county in a mid-western state, search was being made for plans of a concrete bridge built some years previously. The assistant, whose memory ran back through several political generations in the office, said that if it had been a design prepared in the office they would have had copies of the plans, all right; but when, as in this case, the county commissioners let the contract on a bidders' "picture" plan for lump sum, the office had nothing to go by but the picture. And that would not tell much, if found, as to how the bridge was built.

No field notes would be found, he was sure, because as the grade at a bridge is already established by the existing road, the man giving levels would simply assume a bench and lay out the work. There would not be any correspondence either, or records in the files, because in those days they never wrote any letters or had any correspondence. The new county engineer had different ideas, and now they had a stenographer and the files were filling up.

The search did not turn up any data, beyond what the assistant carried in a memory as accurate as a wax record, but did bring out some pictures and stories of happenings to the county's bridges.

The first narrative was of an automobile that was being driven back to the city from a lake resort late at night—the owner was on his vacation, and the chauffeur had picked up four pals.

"They steered straight for the center of the end post of this little three-panel truss span, on a piece of straight away road. That end post consisted of two 5-in. channels and a 14x¼-in. plate, but the two channels were cracked sharply in two and the machine ploughed through until it reached the vertical post. We found a little blood on the railroad trestle across the creek where one man lit, and the tracks where another had crawled out of the creek, but none of them were badly hurt. You know, that machine acted as a substitute for the batter post

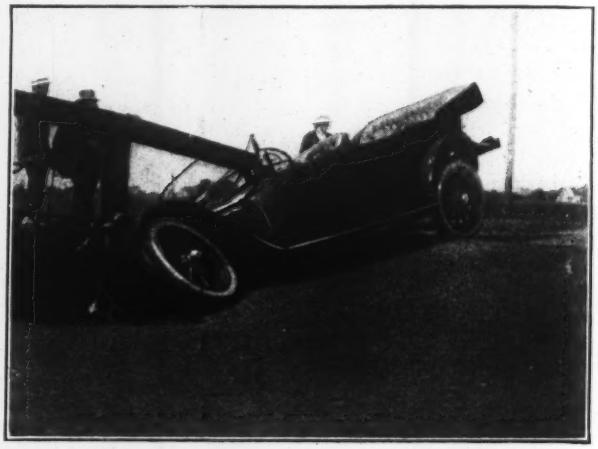


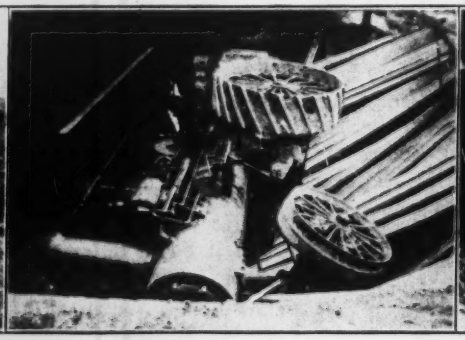
FIG. 1. AUTOMOBILE TAKES PLACE OF END POST

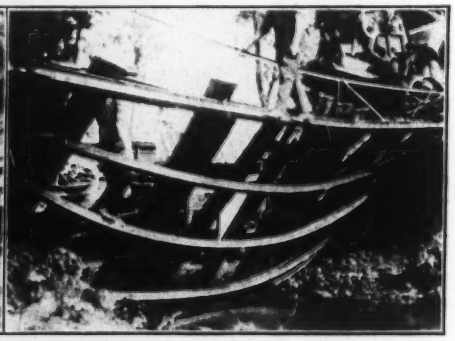
it had smashed. It was wedged in so tight it held the bridge up, and a farmer drove a heavy wagon over before we got there to rope off the bridge.

"Here's a picture of another accident that happened in the county last year. A notoriously reckless driver, intoxicated, coming at a high rate of speed down this road, hit the lattice handrail at the side of a little beam span. He caught it between his wheel and the springs and tore it out of the concrete it was embedded in and carried it 60 ft. The impact slewed his machine around end for end and upside down and up again. The driver was killed.

"Here's a traction-engine accident. The engine and separator crossed this span at noon, threshed a farmer's grain, and then at the end of the day started back to get a set-up for the next day's work. Engines like that had been crossing the bridge every year, but this time this one went through. That's a 29-ft. span, 16-ft. road-

FIG. 2. AUTO CARRIED AWAY LATTICE RAILING





FIGS. 3 AND 4. TRACTION ENGINE WENT THROUGH BRIDGE OF 7-IN I-BEAMS

FIG. 5. FARMER'S BRIDGE OF LIGHT RAILWAY RAILS

way and is carried by seven 7-in. I-beams. No, the planks weren't fastened to the beams; there's a strap to hold them down at the ends. The beams just rested on the abutments at the ends, and one abutment had been raised with a couple of planks between I-beams and masonry, and these had rotted and let the beams turn over.

"Yes, we've got quite a number of those spans. A number of years ago a farmer-contractor filled the county full of them, all with that typical T-iron handrail. He put in 7-in. beams always, regardless of span, using six on short ones and seven on the longer ones. Of course, when he built them, they didn't have 15-ton road rollers, and their heaviest traction engines weighed three or four tons. Now we use 12-in. beams at that crossing, embed the ends in concrete backwalls and put on a plank and creosote-block floor.

Some Weak Ones That Stand Up

"Some of the farmers call our bridges extravagant, though. Here's one that the owner built on one of his farm roads for $50. Its span is 19 ft., 12-ft. roadway, and it is carried by five railroad irons, 3 in. deep, and over that 4 in. of concrete. It sags about 4 in.; but I guess he drives over it, and I've seen several cows on it. It shook when I walked over it. Strange what things will stand up.

"We've got a concrete culvert on one road, which takes traction engines and everything else that comes. The span is 5 ft., and the top slab is 8 in. thick and was designed to be reinforced. The reinforcement hadn't come when the forms were finished; and as the contractor thought it would be strong enough anyway, he filled the forms with plain concrete. There's only 12 in. of cover over, but it has never even cracked."

Experiences with Unemployed on Road Rock Breaking

By Norman R. Martin*

During the winter of 1914-15, incident to the very distressing hard times and the wet, harsh weather, comparatively speaking, for southern California, there were a great many men out of employment. Some were residents of our own county, and others had sought southern California for one reason or another. It was imperative that something be done, and work was given many hundreds of these men on the county roads, cleaning up the weeds from highways, etc. They were paid $2 per day. In this manner the county spent something like $207,000. I believe it is fair to assume that this was not exceeding 50% efficient labor—not perhaps because the men were not capable, but because of the character of the work and the fact that the supervision was not as efficient as it might have been.

In order to obviate this condition and also to demonstrate that in my opinion a large percentage of the men involved did not want real work, the plan of rock breaking was developed. The County of Los Angeles does a great amount of highway building, these roads having concrete base. From 3,500 to 4,000 tons of broken rock is required per mile of highway. When broken by machinery, this rock costs approximately 60c. per ton, laid down on the work. The thought was to have this same rock broken by hand on the ground and paid for at so much per cubic yard instead of by the day rate, and then from an "Unemployed Fund" absorb the difference between what it cost to break by machinery and what it cost to break by hand, which experience developed was about 30c. per ton. In this way practically two-thirds of the amount of money expended was diverted to value-received labor and practically one-third was absorbed from an "Unemployed Fund." Breaking the rock at so much per cubic yard took care of the men who were not so strong physically as others and also made the men produce the goods. The camp was run by the Road Department, and the men were furnished by the Department of Charities. The men paid the camp 25c. per meal. The lodging was furnished by the county, but the bedding was furnished by the men.

One of the most important features in connection with this trial was to demonstrate who wanted to work and who did not. This policy also eliminated a great many applicants from the Outdoor Relief Division of this department.

Whereas more than 6,000 men were registered in the winter of 1914-15, less than 1,600 registered in the winter of 1915-16. All were offered work, and less than 900 accepted, notwithstanding the fact that the average man could earn $2.50 per day. The county spent $207,000 in 1915-16 and last winter spent less than $25,000, accomplishing the same result.

It might be interesting to note that from careful records kept we ascertained that practically one-third of the men involved would not work; one-third would work enough to keep body and soul together and get a few dollars ahead to leave the section and get away from the work; and practically one-third were good and willing workers.

*Superintendent of Charities, County of Los Angeles, 121 Temple St., Los Angeles, Calif.

Roughening Concrete Floor for Resurfacing

By Charles A. Hirschberg*

A change in plans for dry dock No. 1, Balboa terminal of the Panama Canal, necessitated the resurfacing of 113,120 sq.ft. of concrete floor. It was deemed advisable to chip the floor before placing the mortar finish on the old concrete, and a more rapid means was sought than that of the hand chisel and hammer.

Two standard Ingersoll reciprocating tripod drills, air operated and of 3⅝-in. cylinder diameter, were called into use. The tripods were altered as shown in Fig. 1. At the end of each tripod leg an extension was welded, as shown at *A*, a hole being drilled at *B* to take the trunnion

*Ingersoll-Rand Co., 11 Broadway, New York City.

of the hand-made fork *C*, which carried an axle at *D*. An old pulley wheel *E* was mounted on each axle.

The complete apparatus is clearly shown in Fig. 2. The drilling machine is thrown back slightly, so that the crossbit strikes the concrete at an angle, presenting only bit corners to the surface as the steel rotates. With each blow struck, the recoil tends to move the machine and tripod, thus materially assisting the helper in keeping the machine moving. The bits used were of the standard cross type, 8 in. in diameter. It was found that one machine, operated by two men, did as much work in 8 hr. as 50 men could do by hand, and all the work was therefore performed with the two machines.

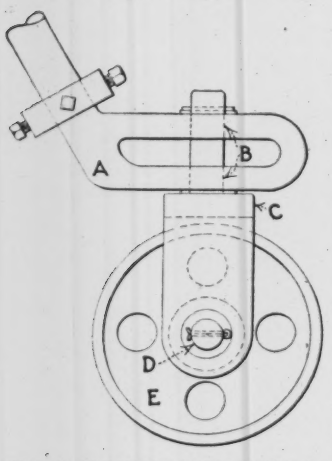


FIG. 1. TRIPOD AS ALTERED

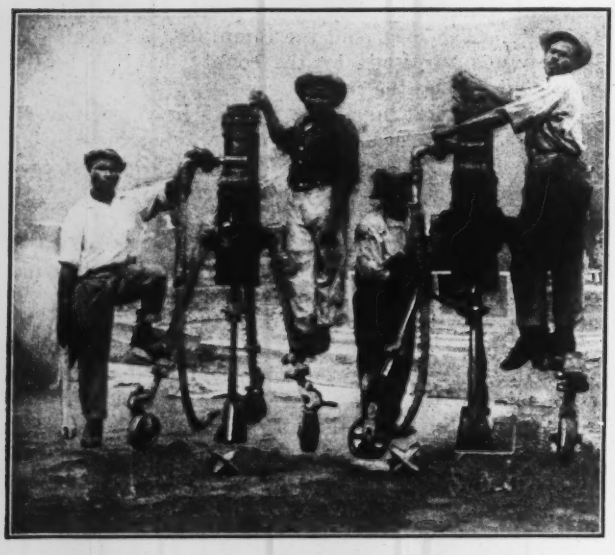


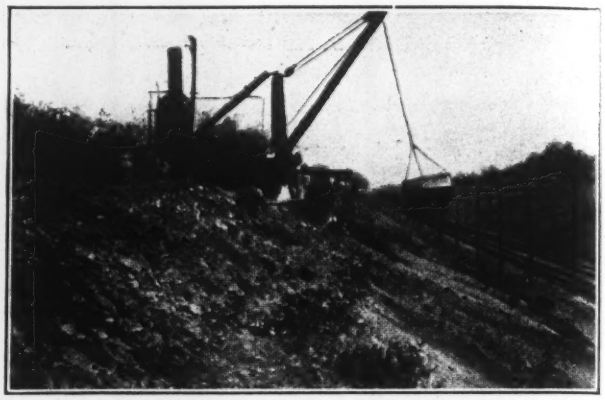
FIG. 2. TWO TRIPOD DRILLS USED TO ROUGHEN CONCRETE FLOOR

Acknowledgment is made to Z. T. Stagg, Jr., who was in charge of this work, for the data.

FINE AGGREGATE

The Somersaulting Bridge shown on p. 560 of the issue of Sept. 21, 1916, in the sketch was not shown sufficiently agile. It is reported now that the post marked A in that sketch was pulled up by the roots and turned completely over the other post, which acted as a pivot, its base remaining in the original position.

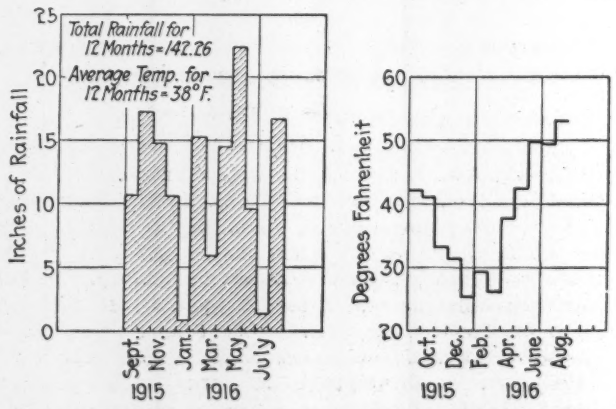
Trimming Cuts on the B. & O. R.R.—A traveling derrick with skips was used in clearing a long cut on the Baltimore & Ohio R.R. near Muirkirk, Md. The north side of the cut for about 2,500 ft. had been badly gullied, and the material washed down had clogged the track ditch. The cut is about 30 ft. deep. At the top of the slope was installed a derrick



DITCHING AND TRIMMING A CUT ON THE BALTIMORE & OHIO R.R.

car consisting of a timber platform or truck mounted on four wheels and carrying a boiler, a 15-hp. double-drum hoisting engine and a stiff-leg derrick with 30-ft. boom. This car ran on a wide-gage track, which was picked up in the rear and relaid ahead as the work progressed. The material excavated was loaded into open flat boxes of 12 cu.ft. capacity, which the derrick raised and dumped to form a broad flat fill about 4 ft. from the top of the cut. This bank serves to stop drainage toward the cut and renders a top ditch unnecessary. The plant and work are shown in the accompanying view. The ditch was cleared out and the slope dressed to a uniform surface. The slope was then covered with street sweepings and sown with grass seed to form a permanent protective covering. The force and organization were as follows: 1 foreman, 1 engineman, 16 men trimming the slope and filling the boxes, 1 or 2 men at guy lines to guide the loaded boxes up the slope and haul the empty boxes back into position, 1 man at top of slope to trip the boxes and spread the material in the fill, 2 men shifting track, 1 cart and driver to haul coal and water, 1 water boy, 1 night watchman. This force could handle about 400 boxes per day. The cost was less than 60c. per yd., as compared with 90c. estimated for contract work. This method of working was planned by H. M. Church, Division Engineer of the Baltimore & Ohio R.R., and the above information is slightly condensed from an article by him in the "Baltimore & Ohio Employees' Magazine." Mr. Church states that for seeding the slopes a mixture of alsack clover, blue grass, alfalfa and oats is used. After seeding, the surface is covered with about 6 in. of street dirt or street sweepings from the large cities, this being shipped in cars and distributed by teams and men with wheelbarrows. This method has been found very satisfactory, and after the first season it is easy to maintain the slopes. In case of the slopes being cut by water during heavy storms before the seed takes root it is necessary to go over the work again.

A Rainfall of 142 In. in Alaska—The accompanying chart of rainfall and temperature for 12 months from September, 1915, at Latouche, Alaska (Lat. 60° 02′ N., Long. 147° 53′ W.), has been sent by B. H. Dow, of Seattle. The total annual



rainfall was 142.26 in., and the average temperature was 38° F. The extreme variations in rainfall as from 22.4 in. for May to 1.5 in. for July, are notable.

Editorials

Road Improvement in Missouri

Missouri, it will be remembered, was one of the first states to establish "highway improvement" by annual good roads' days—spectacular, picnic affairs when the governor of the state wields a pick and shovel to the accompaniment of a brass band and movie operators, and everybody shows his patriotism by putting in a day or two of labor "improving" the roads and having a good time generally. All this has its purpose and is a legitimate means of stirring up enthusiasm. Let the good work go on.

Still, it is a kind of interesting coincidence that we find Clay County, in this same State of Missouri, voting a bond issue of $1,250,000 for road improvement and then having the state's legal lights discover that under the law authorizing the bonds no part of the sum thus raised can be paid for engineering supervision, and that under the law this engineering work must be performed by a Deputy County Surveyor, whose salary must not exceed $4 per day.

We make a motion that the $1,250,000 be expended for liquid refreshments at the next two annual "good roads' days."

An Engineer's Plan To Prevent Strikes on Public Utilities

The engineering profession is taking great interest at the present time in the proposition that engineers ought to occupy a more prominent position and wield a larger influence in public affairs. It is of especial interest, therefore, to record that a distinguished engineer has worked out a plan for the prevention of strikes in the operation of railways and other public utilities. This plan is to be submitted by the Merchants Association of New York City to the Chamber of Commerce of the United States with the recommendation that a general referendum vote on the plan shall be taken.

The originator of this plan, Henry R. Towne, was President of the American Society of Mechanical Engineers in 1889. He has long been President of the Yale & Towne Manufacturing Co., of Stamford, Conn., and he was for several years President of the Merchants Association of New York.

The most important element in Mr. Towne's plan is the provision that every employee of a public utility corporation should have a definite written contract for a stated term of service. During that term he should be neither at liberty to quit his service with the company, nor should the company be free to discharge him. If either party to this contract breaks it, a stated money penalty should be forfeited to the other party.

The company should have, however, the right to terminate the contract because of "misconduct" by the employee, to be defined in the contract, and also, in the case of certain classes of employees, because of slack business, in which case however the employee should receive either thirty days' notice or two weeks' pay and immediate release. The company may also terminate the contract because of the disability or superannuation of the employee, subject to such pension provisions as may exist. An employee should also have the right to terminate the contract because of valid family or personal necessity, or because of illness. The employee could also terminate the contract for any cause on giving fair notice, say thirty days, without penalty, if the company consented.

These and other details suggested by Mr. Towne will of course be varied more or less to suit special circumstances of different employments. The underlying basic idea on which his proposition rests is that in the operation of public utilities, where the public has a right to continuous service, the old idea that the employer has a right to discharge a man without notice, for any reason or no reason, should be done away with, and also the idea that the employees, either singly or in combination, are free to quit without notice.

The recent threat of a nation-wide railway strike, with the surrender of the Government to the railway brotherhood demands, has had one valuable result. It has brought home clearly to the mind of every thinking man the conviction that in some way or other the right of the public to uninterrupted service on public utilities must be established. If there was any disposition to forget this lesson, the strikes which have occurred during the past month on street railway lines in various parts of the country have served to fix it firmly in the memory of everyone.

The right of the public to control the capital engaged in the operation of public utilities is now so firmly established that no one thinks of denying it. The man who invests his money in a railway or a public water-supply or an electric lighting plant does so with the full understanding that the public authorities have the right to control the service which he must render to the public and fix the prices which he may charge.

The next step must be to establish the equal right of public control over the labor engaged in public utilities. Until this is done, fully and completely, the public must expect to suffer, at longer or shorter intervals, more or less inconvenience, loss and destruction owing to interrupted service, which may on occasion rise to the proportions of a national calamity.

There is no doubt whatever that this is the logical way to prevent strikes on public utilities, but the question is, How can this plan be put into operation? Labor organizations will exert their united influence against such a proposition. The capital invested in public utilities has to yield certain of the rights and privileges which it enjoys when engaged in private industry and submit to public control. It does this willingly because of the other privileges which it receives. What privileges can be given to the employee of a public utility company that will so compensate him as to make him also willing to submit to public control and to relinquish his right to strike?

A partial answer, at least, to this question is furnished in Mr. Towne's plan described in the foregoing. It is a real and important advantage to the workman to have a definite written contract of employment for a definite time. He is given something that he has never before possessed—a legal right to his job. This in itself is a very great gain.

It is of interest in passing to note how tardy has been the recognition by employers generally that an employee has any right to his position, and that the employer has not the moral right as well as the legal right to discharge a workman without notice, often for no other reason than a fit or ill-temper on the part of a foreman.

It is, of course, evident that for the successful working of Mr. Towne's plan or any other plan to prevent strikes a strong arm of the public authority must step in to see that justice is done by both sides. Mr. Towne's plan proposes first a board of arbitration, constituted by joint action of the company and the employee, authorized to supervise the relations between the two and pass upon any matter of dispute between them. An appeal from decisions by this joint board would lie either to some existing public utility commission or to a special board created for that purpose.

It is of interest to note further that Mr. Towne, who has for many years taken an active interest in labor questions, preserves in his plan the right of collective bargaining, permitting the employees to have membership in any lawful organization without discrimination on the part of the company, giving the employees the right to request concessions in wages, hours of work, or conditions of service, either alone or in combination with others. He distinctly specifies, however, that the employee, in consideration of these privileges, shall respect the right of the public to interrupted service and not combine with others to cause its interruption.

In presenting this plan before the Merchants Association, Mr. Towne disclaimed that it was complete or final. He presented it rather as an outline of the principles which must be established in custom and in law if the public is to be protected from great loss and disaster.

The question what can be done to protect the public from the calamity of a nation-wide railroad strike or the people of a city from the deadlock resulting from a street railway strike or the interruption of other public utilities is a question which urgently demands solution. The so-called eight-hour law, pushed through Congress at the close of its session under whip and spur, settled nothing, nor do the successes of the one side or the other in winning or defeating an isolated strike settle anything.

No question is ever settled until it is settled right. This question will not be permanently settled until the rights of the public are made superior to the rights of both employer and employee, and until sufficient concessions and privileges are granted to each of these parties to make them willing to accept in good faith the superior rights of the public.

Engineers who believe that the members of their profession are destined to occupy positions of larger public influence may well be gratified to have the plans of an engineer for settling this grave public question brought forward by the Chamber of Commerce of the United States. There is further testimony to the public's appreciation of the engineer's opinion on other than technical questions and to its belief in his judicial fairness in the appointment of General Goethals as Chairman of the Commission to study the operation of the Adamson eight-hour wage law, and, in the general public approval with which that appointment has been received.

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Coal Wealth of United States and Industrial Supremacy

At this time, when so much interest is taken in the question as to the future position of the United States in international trade, great importance attaches to the statistics of the world's coal resources presented at the recent meeting of the British Association for the Advancement of Science by the Committee on Fuel Economy. This committee was made up of scientists and engineers of international fame, including such men as W. A. Bone, J. A. F. Aspinall, Sir Hugh Bell, Dr. Dugald Clerk, Sir Robert Hadfield, Dr. H. S. Hele-Shaw, Dr. Charles Parsons and Benjamin Talbot. The committee in opening its report said:

> It can hardly be questioned that the chief material basis of the great industrial and commercial expansion of Great Britain during the past century has been its abundant supplies of easily obtainable coal, which, until recent years, has given us a position of advantage over all other countries. It is also equally true that we can no longer claim any advantage in this respect over our two closest competitors. If anything ought to arouse public opinion to the gravity of the situation, it is surely afforded by the statistics on the world's coal resources issued by the International Geological Congress in the year 1913. This estimate gives the geographical distribution of the world's total probable reserves of coal of all kinds available within 6,000 ft. of the surface, amounting in all to 7,397,533,000,000 metric tons.
>
> The fact that the available reserves of coal in Great Britain only amount to about one-fortieth, while those of the whole British Empire do not amount to more than about one-fourth of the world's estimated total, is one which ought to be brought home to everyone responsible for the economic development of our national and imperial resources. The United States, whose competition in the immediate future will probably be much more severely felt than ever before, possesses more than half the estimated world's coal, and in regard to quality and cost of production she probably compares favorably with Great Britain.

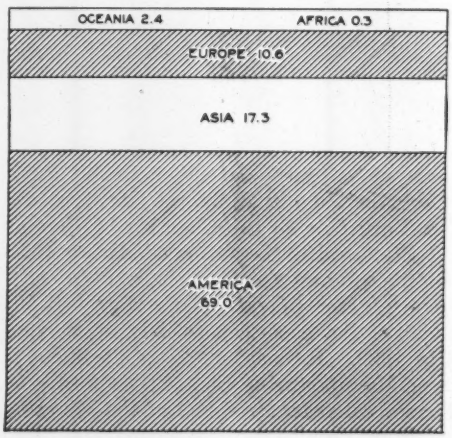


FIG. 1. PERCENTAGE OF THE WORLD'S COAL DEPOSITS ON THE DIFFERENT CONTINENTS

Two diagrams from the report of the International Geological Congress are reproduced herewith, showing the geographical distribution of the world's coal supply. It will hardly be questioned that the fuel resources of a country are more important than any other influence in determining its future industrial position. It is true

that for certain industrial operations the development of hydraulic power and its utilization by means of electricity can to a limited extent take the place of coal; but it is to a limited extent only, and there is every reason to believe that the future manufacturing industries of the world will have their geographical location largely governed by the existence of cheap fuel.

In its stores of other mineral fuel, such as petroleum and natural gas, the United States also, so far as is at

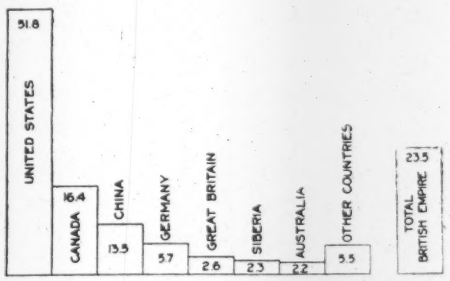


FIG. 2. PERCENTAGE OF THE WORLD'S COAL DEPOSITS POSSESSED BY VARIOUS NATIONS

present known, exceeds any other country in the world. The enormous increase in the use of both liquid and solid fuel has already produced a world-wide increase in the prices of these fuels and is destined to produce a much greater increase in future. The importance of the United States' vast fuel reserves, therefore, in giving her an advantage over other nations in international competition is certain to be much more potent in the future than it has been in the past.

It is a narrow point of view, however, to study these statistics solely with reference to the competition of one nation with another. The British association's committee uses these statistics to urge the importance of more economical utilization of fuel, and the same lesson needs to be taught in the United States.

For the future welfare of the world's population the conservation of natural resources is a matter of vastly greater importance than even the question of supremacy in the world-wide struggle of races and nations now going on. The wasteful use of natural resources, of which the present generation is guilty, is destroying the chances of life and prosperity for many millions of unborn peoples.

Not only are present methods of burning coal exceedingly wasteful, as for example the coking of coal in the beehive oven; but a large proportion of the coal in the mines is rendered forever unavailable in the process of mining simply because, as the British committee puts it, "under present individualistic conditions it does not pay to bring all the coal to the surface. A larger profit on the capital of a colliery company can often be earned by working the better class of coal and leaving the less valuable grades underground."

In 1905, a British Royal Commission on Coal Supplies reported that of the 167,000,000 tons of coal then used by Great Britain, between 40,000,000 and 60,000,000 tons could be saved if economical methods of using the fuel were adopted. While the United States possesses enormous reserves of fuel supply, it has already exhausted to a certain extent the most conveniently worked deposits, so that the cost of coal to the consumer has materially advanced over that prevailing a quarter-century ago, and the advance is probably permanent. Therefore, notwithstanding the enormous reserves of fuel which the United State possesses, conservation of the coal supply—means to mine and burn coal with maximum economy—is justified commercially at the present day.

Lessons from Ohio Cities

Some Ohio cities are puzzled to know how they are to pay their running expenses. A few years ago the state limited the tax rates to 1% on the assessed valuation. Another state requirement makes it the duty of every municipality to make annual provisions for the retirement of its bonded indebtedness when it matures.

This last named law appears to have been unenforced until recently. On Aug. 4 of this year the Supreme Court of Ohio handed down a decision requiring the Cleveland Budget Commission to appropriate a sufficient amount to meet the annual sinking fund charges in accordance with the law. This decision, it is stated, will require the city to devote $1,500,000 of this year's tax levy to sinking fund payments. At the same time it brings home to other cities the necessity of meeting their sinking-fund obligations.

There can be little question as to the wisdom of this law and of its strict enforcement; but, coupled with the law limiting the amount of money which can be raised by taxation, Ohio cities find themselves in a quandary where to find the money for current expenses. It is reported that Toledo's Mayor and principal officials had to go without their salaries in August while other city employees entitled to over $1,800 a year got only half pay.

It seems unlikely that such a state of affairs could have arisen if these cities had been in the habit of living up to their sinking-fund obligations and had followed well recognized budget procedure. Much hardship may have been worked by the 1% tax limit but its existence was no secret, any more than the sinking-fund requirement. Both should have been taken into account when the appropriations for the current year were made.

If most of these Ohio cities are not lax and wasteful in the conduct of their affairs, it would be surprising. The chances are that the larger part of their work and supplies cost more than they would under efficient management, that municipally-owned utilities that ought to be self-sustaining are being run at a loss, and that the deficiency, often unknowingly, is being made up in the general tax rate.

The conditions reported and conjectured are not peculiar to Ohio—more's the pity—except that so low a tax limit is probably unusual, and that Ohio is more progressive than most states in its supervision of municipal affairs. It has had a state audit of municipal accounts for a number of years and is therefore in better position to bring its cities and villages to book than are most other states. The probabilities therefore are that Ohio cities seem to be in an uncommonly bad plight largely because of investigation and publicity that is lacking in many other quarters. The whole subject is one that should make a strong appeal to engineers, whether in city or private practice. Public improvements cannot be provided and maintained and the wants of city dwellers supplied if municipal affairs are not conducted on a sound financial basis and at least some approach toward a dollar's worth of work secured for every dollar spent.

Letters to the Editor

The Quebec Rocker Stresses

Sir—There could not have been news more unexpected in the engineering world than the news of the failure during erection of the suspended span of the Quebec Bridge. Engineers the country over were assuming that the construction and erection of this, the largest of all bridges, would be executed in such a way as to make a failure of this kind practically impossible.

Your issue of Sept. 21, 1916, gives such a complete record and arrangement of evidence as to leave no possible doubt of the immediate cause of the accident. Now that the event is a thing of the past, some evidence may be added to the total of our experimental knowledge on the behavior of steel castings in flexure and shear. [Stress calculations here given by the author are superseded by the slightly more accurate figures given by the article in *Engineering News* of Oct. 5, 1916, which appeared after this letter was written. He points out the high shearing and bending stresses.—Editor.]. The weakening effect of the pin slots in these arms is tremendous because of their location, which happens to be on the tension side and at the outer edge.

If the reaction of 1,185 tons is the static load reaction then there should be a considerable increment added for the effects of lifting the truss. This 1,185 ton reaction is truly a moving load so far as the rocker arms are concerned, and should by all the rules of practice be increased by 50% in proportioning the rockers. As these rockers were of what is known as low-carbon steel castings, the flexural strength at the yield point probably would not have reached 30,000 lb. per sq.in. In view of the fact that the rockers had been repeatedly stressed beyond the yield point, previous to the day of failure, it seems remarkable that not one of them showed signs of failure or distortion before. G. L. BILDERBECK,

Rivers, Harbors and Bridges Commission.

New London, Conn., Oct. 2, 1916.

High Stresses at Center of Quebec Rocker Casting

Sir—The calculations of the rocker castings under the suspended span of Quebec Bridge, given on page 651 of *Engineering News* for Oct. 5, 1916, make no reference to the stresses existing in what was apparently the weakest section of this casting—namely, the transverse section immediately under the center line of the upper pin. Have you any information as to what unit stress was computed by the designers or the Board of Engineers in this particular section? FRANCIS P. WITMER.

85 Clinton St., Brooklyn, N. Y., Oct. 9, 1916.

[Apparently the midsection stress was not computed by either the St. Lawrence Bridge Co. or the Board of Engineers.—Editor.]

Sir—In *Engineering News* of Oct. 5, 1916, the cause of the disaster to the Quebec Bridge has been traced to the breaking of the steel rocker at the southwest end of the bridge. The stresses computed by the St. Lawrence Bridge Co., the Board of Engineers, and *Engineering News*, were determined for a section at the root of the cantilever. The maximum bending moment on the casting is at the center line of the upper pin, and the stresses at this point should not be overlooked.

Assuming the distribution of the pressure on the lower pin to vary as a parabola, which is between the triangular and uniform-load assumptions, the computations for the bending moment at the center are as follows:

Calling p the pressure per lineal inch of pin on the middle 9½ in. of length of the lower pin, the total pressure on the 9½ in. length is $9\frac{1}{2}p$, and the pressure on the two bracket arms is $2 \times \frac{2}{3} \times 16\frac{1}{4} \times p = 21\frac{2}{3}p$; then the total pin reaction is $31.16p = 2{,}370{,}000$ lb. This gives $p = 76{,}000$ lb. The bending moment at the center then is $\frac{2}{3} \times 16\frac{1}{4} \times 76{,}000 \times 10.85 + 4\frac{3}{4} \times 76{,}000 \times 2\frac{3}{8} - 1{,}185{,}000 \times 2 = 7{,}438{,}000$ lb.-in. This assumes that the upper pin distributes its load equally over its 8-in. diameter.

As the diameter of the pin hole is slightly larger than that of the pin [0.02 in.], and the edges at the top of the casting are only ¾ in. thick, it is questionable if it is good engineering practice to consider the pin as transferring the compressive stresses between the two cantilever ends. If no stress is thus transferred by side pressure across the pin, the whole moment at the center must be resisted by bending on the net section of the rocker. The section modulus is 152, and the stress in the extreme fiber at the bottom is $7{,}438{,}000 \div 152 = 48{,}800$ lb. per sq.in. The stress in the extreme tension fiber at the root of the cantilever is $822{,}000 \times 6.1 \div 182.5 = 27{,}400$ lb. per sq.in.

Assuming a uniform distribution of the load on the lower pin instead of the parabolic, the tension in the extreme fiber at the center of the casting is $10{,}100{,}000 \div 152 = 66{,}500$ lb. per sq.in.

6119 Ross St., S. A. KEAST.

Germantown, Philadelphia, Penn., Oct. 11, 1916.

[Taking account of the maximum tension at center of rocker length, in comparing with the computations of the designers, reveals even more remarkable conditions than were indicated in *Engineering News* of Oct. 5, 1916.

The section modulus at center is 152.7 in.^{3}, while that at root of bracket is 187.5 in.^{3}, so that the central section is about 20% weaker, in spite of having the great top width of 26½ in. These section moduli are for the lower or tension edge; those for the compression edge are much higher—247.4 at the central section and 228.6 at root of bracket, so that the maximum compressions are in all cases 25% to 40% lower than the tensions. Of course, even apart from this the tensions would be the dangerous stresses.

Besides being weaker, the central section has a larger bending moment to resist. Depending on the precise distribution of the pin reaction, the excess of the center

moment over that at root of bracket ranges from 30% to 300%. The following figures, computed for the load of 2,370,000 lb., are illustrative:

Uniform Distribution of Pin Reaction—Moment at root of bracket 7,450,000 in.-lb.; moment at center 10,070,000. Stresses at root of bracket, 32,600 compression and 39,700 tension. Stresses at center, 40,700 compression and 66,000 tension. Here the tension is 66% greater at the center than at root of bracket.

Triangular Distribution on End Portions—Moment at root of bracket 4,050,000 in.-lb.; moment at center 6,275,000. Stresses at root of bracket, 17,700 compression and 21,600 tension. Stresses at center, 25,400 compression and 41,100 tension. The tension is 92% greater at the center.

Bridge Company's Distribution—With uniform reaction on length of 25.1 in., extending 7.8 in. out from root of bracket, the moment at root of bracket is 2,872,000 in.-lb.; moment at center 5,066,000. Stresses at root of bracket, 12,500 compression and 15,300 tension. Stresses at center, 20,500 compression and 33,200 tension. The tension is 119% greater at the center. The same ratio holds for the design load of 3,000,000 lb., though the stresses then are about 27% higher.

Company's Method Applied to Center—To give 20,000 lb. per sq.in. tension at center, moment at center must be 3,054,000 in.-lb. Actual load (2,370,000 lb.) must be distributed uniformly on length of 18.30 in., or a projection of 4.4 in. beyond root of bracket. The tension at root of bracket then is only 6,600 lb. per sq.in., making the excess at center 200%. Design load (3,000,000 lb.) must be distributed uniformly on length of 16.14 in., thus projecting only 3.32 in. beyond root of bracket. The tension at root of bracket then is only 4,260 lb. per sq.in. making the center tension 4.7 times the tension at root of bracket, an excess of 370%.

While thus the figures for the midsection are of determining importance, the peculiar shape of the rocker makes it likely that an irregular section is the weakest; for example, a break passing through the transverse center line at one end and thence somewhat obliquely to the opposite root of bracket might be a probable occurrence. Also, the wedging pressure of the upper pin might be of influence in directing the path of fracture. The casting is in fact subjected to such a complex set of stresses—both direct and secondary—that analysis can only lay emphasis on the need for ultraconservative design in such a case.—Editor].

Philadelphia Water Rates

Sir—I inclose copy of a proposed ordinance regulating water charges in Philadelphia; also a copy of a letter which I presented at a hearing on the subject. In this letter I took the position that the City Councils are forbidden, by the city charter, to meddle in the conduct of the water-supply by the Department of Public Works.

The meeting amply justified this provision of the city charter. A score or so of men sat, for an afternoon, darkening counsel by words without knowledge and hearing pleas from self-seeking manufacturers, who, getting their water far cheaper than in most other cities, are nevertheless panic-stricken when the city proposes to add a fraction to what must be a very small portion of their outlay.

And the Water Bureau Chief, who could adjust all these matters far better and who seems to be the designated official for the purpose, had to dance attendance upon the committeemen and hear the wearisome discussion.

Rather than bother with such masses of complication as that exhibited on the blanket-sheet, would it not be better to make our water-supply "as free as air" to the consumer, throwing the entire burden upon the same people as taxpayers, but of course with a meter upon every connection and a prohibitory fine for waste?

JOHN C. TRAUTWINE, JR.

257 South 4th St., Philadelphia, Sept. 30, 1916.

[The Philadelphia lawyers will have to decide whether establishing water rates is an executive function with which the city charter forbids the Councils to meddle. The significant thing seems to be that at last there is a fair prospect that meters will be used to curtail the notorious water waste of Philadelphia.—Editor.]

Asphalt-Pavement Patents

Sir—In your issue of Sept. 7, 1916, p. 434, the last sentence under asphalt-paving history is a question as to whether any pavement of the type mentioned has been patented in the United States. I think the patents granted to Edward M. Chadbourne, of San Francisco, Calif., are on a pavement of this type. His patents are the following: 956,940; 965,562; 982,247; 994,092, 1,103,127. LEONARD L. HOHL.

Sausalito, Calif., Sept. 16, 1916.

Chicago's Heavy Street Traffic

Sir—An item on p. 597 of *Engineering News* of Sept. 28, gives traffic figures on Fifth Ave. at 42d St., New York City, which is claimed to have the heaviest traffic in the world.

Pardon us for presuming that Chicago can beat these figures, but the following figures were taken from the *Chicago Tribune* and are an efficient counting by the Police Department: State St., between Madison and Washington St., Chicago, on July 19, 1915, had 11,674 vehicles passing between 8 a.m. and 6 p.m., or 1,167 per hr.; on Rush St. bridge, Chicago, on July 13, 1915, there were counted 13,600 vehicles between 9 a.m. and 6 p.m., or 1,511 per hr.

If the traffic on Rush St. bridge had been taken from 8 a.m. to 7 p.m., a much greater figure per hour would have resulted, in my estimation, for from 8 o'clock to 9 o'clock in the morning and from 6 o'clock to 7 o'clock at night are very congested periods. L. S. BRODD.

111 West Washington St., Chicago, Oct. 10, 1916.

NOTES AND QUERIES

Public Improvements Are Proposed in Honolulu, and the municipal government of that city has requested the chamber of commerce and other civic organizations to discuss a proposed loan plan, whereby the government would bond the city for $1,000,000 for certain public improvements, including sewer and water systems, new roads and a city hall. The waterworks department has recommended out of the funds thus obtained the following items: The sum of $150,000 for a filtration plant for the Uuanu Valley reservoirs, $150,000 for a sewerage system for the Waikiki district and $80,000 for water meters. The mayor has proposed $100,000 for the purchase of a lot and construction of a city hall and $100,000 for roads.

Electric Railway Men in Annual Convention

Men interested in all phases of the electric-railway industry—operating officials, engineers, accountants, claim agents, traffic men and supply manufacturers—gathered at Atlantic City, N. J., for the thirty-fifth annual convention of the American Electric Railway Association and its subsidiary organizations. This was the first convention which has been held since the manufacturers were taken into the organization on the same basis as railway companies. This was the first time that the exhibit of electric-railway appliances and the entertainments have been under the direct control of the main association instead of the independent manufacturers' association.

More than ever before, the convention reports pictured the detailed progress of committees in charge of the cooperative efforts of the electric railways thus joined—in matters of administration, publicity, public relations, technical education, standard practice, valuation, compensation for carrying mail, electrolysis, etc., but in comparatively few cases were important developments reported at their climax.

Valuation Nomenclature

One of the most important reports was that of the Valuation Committee (J. N. Shannahan, Newport News & Hampton Ry., chairman) giving a bibliography complete to Jan. 1, 1916, and a list of 21 terms (defined by C. G. Young, Consulting Engineer, New York City) which covered all that were thought necessary in valuation work. In another appendix was a paper by P. J. Kealy (Kansas City Railways Co.) defining the various "overhead charges" which properly could be loaded upon bare construction expenses to obtain truly complete cost figures. Typical allowances for engineering and superintendence, organization and legal advice, interest during construction, contingencies, etc., were cited. It was advocated that overhead items definitely apportioned on depreciating property be amortized but that other overhead charges enter permanent capitalization.

Publicity Doctrines

The subject which aroused the most interest was that of "Publicity," informally but interestingly presented by Ivy L. Lee of New York City, formerly Assistant to the President of the Pennsylvania R.R. His argument was that publicity was the key to successful public dealings but that it must be full and frank and in no way dissembling. A utility entering on a policy of publicity must be prepared to furnish the best service possible under the situation.

The discussion consisted of questions largely; the session was a little startled by the statement of T. N. McCarter, President of the Public Service Corporation, Newark, N. J., that he sometimes felt that the public did not care whether it was fair or not—that possibly the fairness of the people could not be relied on.

This same topic was taken up by A. B. Leach (A. B. Leach & Co., bankers, of New York City) in a later address on "The Financial Development of Electric Railways." But Mr. Leach reiterated his firm faith in the fairness of the people and attributed any existing hostility toward utilities to lack of knowledge.

The committee on Public Relations (Chairman, C. Allen, Syracuse, N. Y.) reported that the ambitious publicity program proposed by earlier committees—distributing literature, furnishing lecturers, newspaper advertising, etc.—had not been carried out through failure to secure the necessary funds. On account of the growth of local company periodicals and other publicity work the committee recommended that the best and most economical effort which the association could make would be to establish a bureau for supplying local companies with authentic data, important commission decisions, notable addresses, etc., for assisting in supplying speakers for local meetings, and articles for newspapers and periodicals.

Social Insurance

A subcommittee of the Public Relations Committee (J. D. Mortimer, Milwaukee, Chairman) presented a review of the development of protection and betterment insurance schemes to be found in various countries. It did not discuss the desirability of such insurance but showed what had been done—by governments, employees' organizations, employers, coöperative associations, and underwriters—what could be provided for certain sums, what errors were prominent, etc.

Future of Electric Roads

F. J. Sprague (Consulting Engineer, New York City) in an address on "The Physical Development of Electric Railways," held up the use of electric traction on steam lines as the one bright spot in the future of electric railroading—through financial advantage there.

The Committee on Taxation Matters (Chairman, H. S. Lyons, Boston Elevated Railway Co.) reported generally continued increases in the burdens placed on electric railways by states and municipalities—direct taxation, better cars, more paving, more support of regulating commission, more detailed reports, shorter hours of labor, increasing cost of workmen's compensation acts, etc.

Engineering Association

The Committee on Power Generation recommended the adoption of the American Society of Mechanical Engineers Boiler Code as standard, and the convention accepted it.

The Committee on Buildings and Structures (Chairman, C. F. Bedwell, Public Service Ry., Newark, N. J.) presented several designs of steel, concrete and wood fences for rights-of-way, of modern oil houses, of improved expansion joints for reinforced concrete, a new form of contract and general specifications.

The Committee on Heavy Electric Traction (Chairman, E. R. Hill, Consulting Engineer, Pennsylvania R.R., New York City) offered tables of the characteristics of electric locomotives in use on important steam and electric railways of the world.

The Committee on Equipment (Chairman, W. G. Gove, Brooklyn Rapid Transit System) reported revised standards for wheel contours, steel-wheel designs, brakeshoes, axles and journal parts. Progress in matters of car ventilation and lighting and painting was reviewed without recommendations.

The Committee on Power Distribution (Chairman, C. L. Cadle, New York State Rys., Rochester, N. Y.) offered revised standards for overhead construction, tabu-

lated information on third-rail construction, etc. Its most notable contribution, however, was a monograph on the theory and design of reinforced-concrete poles—based on its own studies and experiments. This section of the report discussed such topics as the theory of beam flexure applied to reinforced-concrete poles, derivation of flexure formulas, effective distance of reinforcing, allowable pole loading, pole dimensions at any section, and computations of strength.

New Officers

The following important officers elected are noted from the complete slates:

American Association—President, L. S. Storrs, president of the Connecticut Co., of New Haven; vice-presidents, T. S. Williams, president of the Brooklyn Rapid Transit System, New York City; J. J. Stanley, president of the Cleveland Railway Co.; J. H. Pardee, president of the Eastern Pennsylvania Railways Co., Pottsville, Penn., and Richard McCulloch, president of the United Rys., of St. Louis.

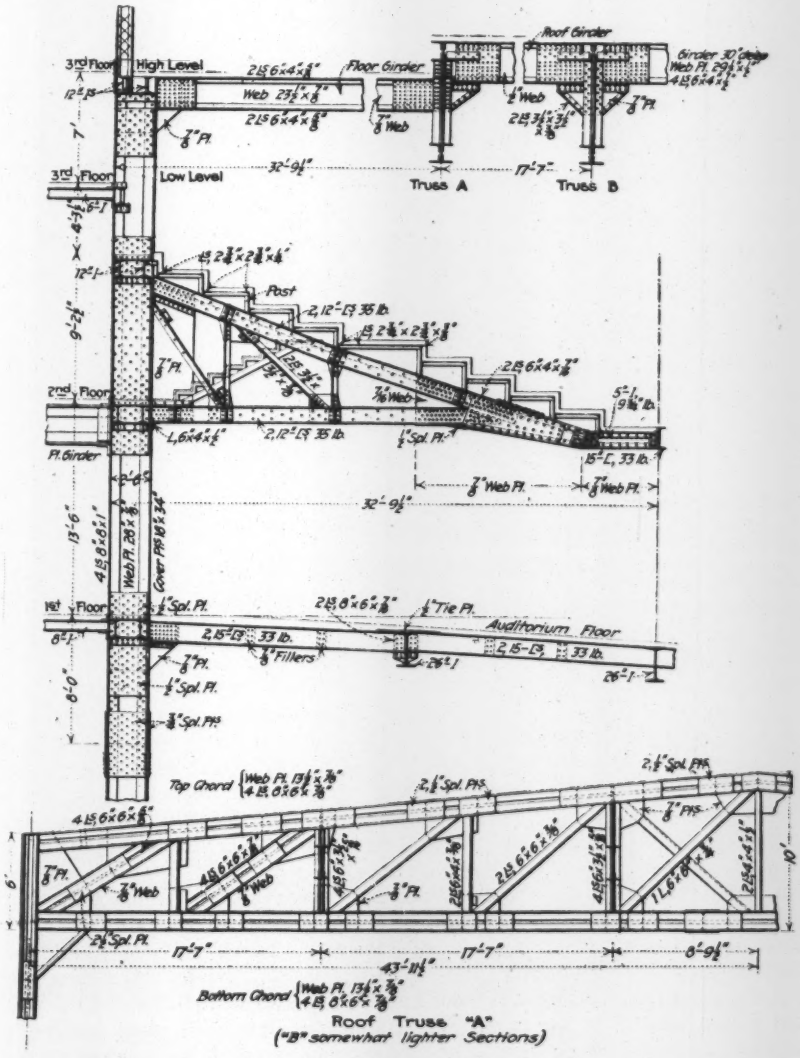
Engineering Association—President, F. R. Phillips, Pittsburgh Rys.; vice-presidents, G. W. Palmer, Jr., Bay State Street Ry., Boston; W. G. Gove, Brooklyn Rapid Transit System; E. R. Hill, Pennsylvania R.R., New York City.

Transportation and Traffic Association—President, L. C. Bradley, Stone & Webster, Houston, Tex.; vice-presidents, W. H. Collins, Fonda, Johnstown and Gloversville R.R., Gloversville, N. Y.; R. P. Stevens, Mahoning & Shenango Valley Ry., Youngstown, Ohio; L. H. Palmer, Eastern Pennsylvania Rys., Pottsville, Penn.

Taking Care of Eccentric Load from Balcony Brackets

In designing the new Huntington High School, the architect, Verus T. Ritter, of Huntington, W. Va., planned for an auditorium with a large balcony, the overhang being about 32 ft. Conditions were such as to make it desirable to carry this balcony without either column supports below or hanger supports above. The brackets were therefore detailed as pure cantilevers from the columns, which put an enormous bending and overturning moment on the columns.

The construction is sketched in the drawing herewith. C. O. Gilbert, of Pittsburgh, Penn., who was structural engineer for the architect on this work, provided columns 30 in. deep which he designed to be capable of transferring the bending from first floor line to roof line, a height of about 33 ft.; this was equivalent to neglecting the uncertain amount of lateral support given by the intermediate floors in that part of the building back of the auditorium. The overturning moment was absorbed at the floor line by the auditorium floor steel, acting in tension, and at the roof line (or high third-floor level) by the compressive resistance of the roof slab and also by bending in the roof girders.



The roof girders, on account of their unusual functions in this structural system, were detailed with joints capable of taking bending, as indicated in the drawing. The stress was carried through the posts of the trusses on which they are supported by means of large gusset plates, and additional strength at the joints was obtained by placing brackets against the truss posts, under the girders. The auditorium ceiling contains two trusses of the kind shown, spaced about 35 ft. Transverse to them are four lines of girders or purlins, spaced 17½ ft., the room thus being about 88x100 ft. The wall opposite that in which the balcony columns are set contains no steel. The roof girders merely rest upon this wall. The thrusts from the balcony bracket columns do not continue to the end of the girders, however, but are transmitted from the girders into the roof slab and thence go into the side walls, whose strength longitudinally is ample to carry this thrust as a shear between roof line and first-floor line. This structure was built during the past year. The steel contractor was the Riverside Bridge Co.

The Value of the Street Railways of Minneapolis has been estimated at $25,914,308 by F. W. Cappelen, city engineer, in a report to the city council. The valuation was made for use in connection with the drafting of a franchise to take the place of one that expires in 1923. The main items in the estimate are $21,152,221 for cost to reproduce new, $4,270,230 for development to a going-concern basis; and $491,308 for water-power leases to July 1, 1923. The valuation cost $14,900.

Building Second Half of the Susquehanna Bridge

SYNOPSIS—The Cumberland Valley R.R. crossing at Harrisburg is being transformed from a single-track steel truss bridge into a double-track reinforced-concrete arch bridge. The south half was built last season without interrupting traffic, and the steel trusses were taken down. The north half is now under construction. Two months' work was lost when a flood in June, 1916, washed out the service trestle, which is a vital factor in the erection.

The second half of the Susquehanna bridge of the Cumberland Valley R.R. at Harrisburg, Penn., is being erected by practically the same method as that employed on the first half last year—that is, from a working trestle. The pneumatic-concreting plant has been abandoned, however, and all concreting is being done by buckets hauled on flat-cars and handled by locomotive cranes. The contractor has about 100 men at work at the present time and expects to finish by December.

Prior to 1915 the Cumberland Valley crossed the Susquehanna at Harrisburg on a single-track deck-truss bridge of 22 spans of 170 to 185 ft. The bridge is being transformed into a double-track concrete-arch structure of 45 spans averaging 76 ft. In carrying out this very large program the old piers were used, being jacketed with concrete as well as extended in length to carry a wider bridge, and between each pair a new concrete pier was built. The railway put in all the footings in three months in the fall of 1914. The first half of the bridge was completed in 1915, as fully described in *Engineering News* of Mar. 23, 1916, p. 537.

At the close of the 1915 season the contractor stored his plant on an island crossed by the bridge. Here also were located the mixing plant and construction office. This island was an important factor in the work.

In building the first or south half a working trestle was built alongside the bridge extending from the island to the Lemoyne bank. The river bed is limestone, making it impossible to drive piles for the trestle, which therefore was erected on sills laid on the rock bottom. The deck carried two tracks for the dinkeys and bucket cars, the two inner rails being of standard gage to suit the locomotive crane that set and shifted the forms and poured the concrete.

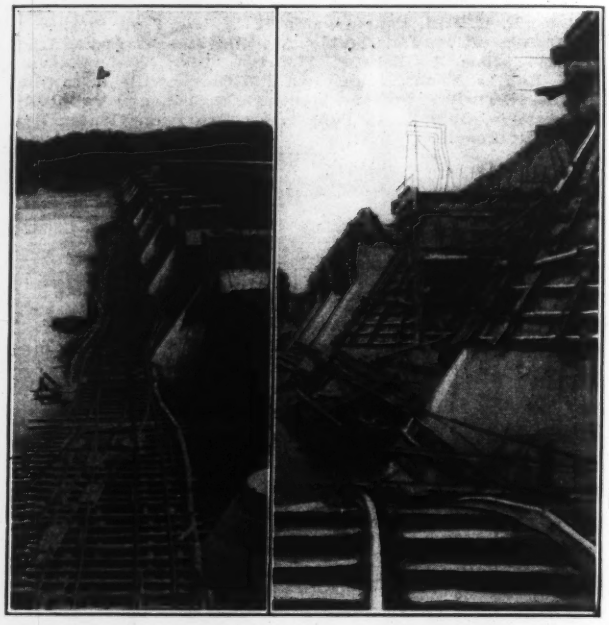
June, 1916, Flood Cost Two Months' Work

Work on the north half started in April, 1916. First, a trestle was built along the north side similar to the one that had been on the south side. The stringers for the trestle were 70-ft. I-beams, used without any punching or riveting, so as to have maximum scrap value afterward.

As soon as the trestle was in place from the island to the east bank, concreting started on the "umbrellas," the piers having already been carried up to springline. One arch had been concreted when a flood came down, damaging the trestle and causing considerable anxiety. The trestle was immediately lashed to the bridge, and it was hoped that it would hold. This flood was only a feeler, however. On June 16 a real flood appeared, which speedily wiped out most of the trestle and seriously weakened the remainder. The steel stringers were bent around the piers by the swift current, necessitating the extensive beam-straightening work described in *Engineering News* of Aug. 31, p. 386.

All work had to be discontinued until the water went down; then the 2,000-ft. trestle was reconstructed, the straightened I-beams being made to serve again.

The plan of attack on the second half was to be similar to that originally devised for the south half, except that



FIGS. 1 AND 2. EAST CHANNEL TRESTLE FOR THE SUSQUEHANNA BRIDGE AFTER THE JUNE FLOOD

Fig. 1—Shows racked trestle remaining after flood had washed out the greater part. Fig. 2—Steel stringers wrapped around the middle pier in view

work was to start at the Harrisburg end and proceed toward the island. As the concreting progressed, the service trestle was to have been torn down and erected from the island toward the Lemoyne end, so that by the time the east-channel spans of the bridge were finished the west-channel spans would be well under way.

The effect of the flood prevented the execution of any logical plan. Instead of working from the east bank, concreting is going on wherever possible. On Aug. 17, nine arches had been poured east of the island. On the west-channel spans no work had been done above springline. On Sept. 16, twenty-three arches had been poured, completing the east-channel spans.

Last season, when work ended on the south half, the steel arch forms were left in place under the arches last concreted. Now when it is decided to pour a certain arch on the north half, the center already in place under the south half of the same span is pulled by a crane to the

new position. Some of the spans are 77 ft., and some are 74½ ft. The same centers can be used for either by the simple expedient of blocking the lagging. There are eleven sets of Blaw steel centers, six spandrel-wall forms, four umbrella forms and four coping forms. The lagging on the centers is made up of two thicknesses of 8x2-in. planks. This lagging will be sold when the contract is completed. As there are so many more arches than arch forms, it is usually necessary to pull a center from a completed arch to the site of another arch. First, the center is jacked up so as to remove the blocking under it, when it is let down on rollers made of 3-in. pipe filled with grout to prevent crushing of the rollers. A block-and-fall is attached to each of the front corners of the form, the two lines running to snatchblocks and being secured to the trestle deck, then to the front of a locomotive crane, to which the block-and-fall is fastened. The crane is propelled forward or backward, and the center is drawn onto trucks of dump-cars and transported to its next position.

The first arch of the east end has a span of 69 ft., and for concreting this a tin-covered wood center has been erected on the job. This same center will be used to concrete the two arches on the extreme west end.

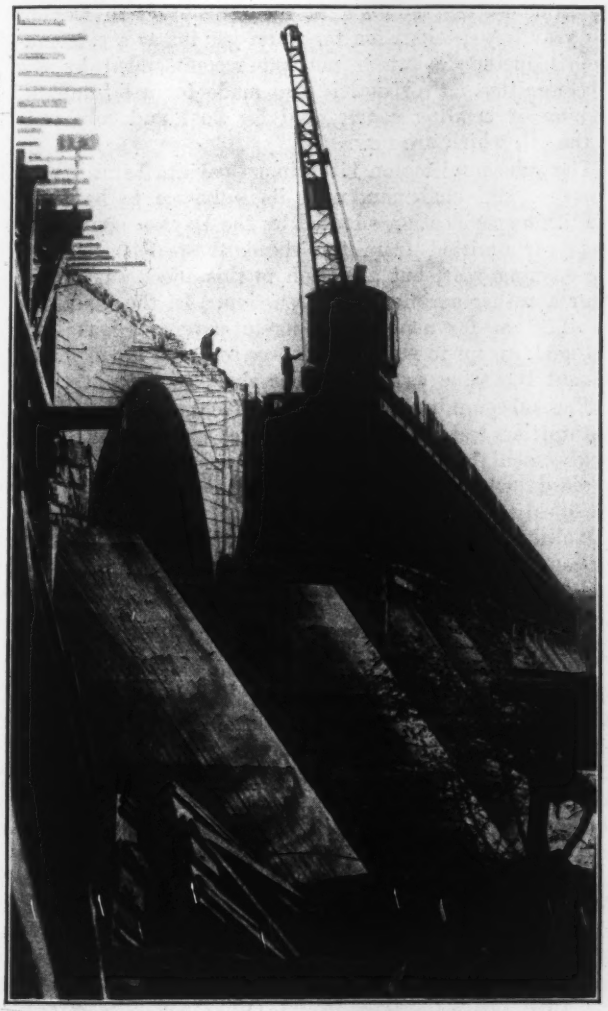
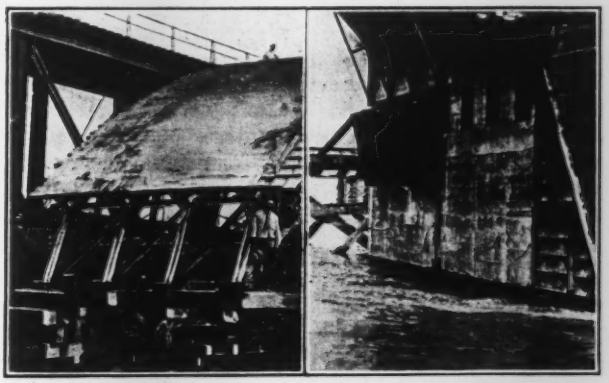


FIG. 3. SOUTH HALF OF THE SUSQUEHANNA BRIDGE, SHOWING STEEL WORK STILL IN PLACE



FIGS. 4 AND 5. MOVING A STEEL ARCH CENTER TO NEW POSITION. STEEL BRACKET SUPPORTS FOR CENTER

Fig. 4—The center is conveyed on trucks of Western dump cars. When the trucks were not in requisition they were usually stored in the river, from which they were fished by crane when needed. Fig. 5—The brackets and center are on a south span. New brackets will be installed on the north and the form will be pulled over on them by crane running on the north trestle

These two arches are also of 69-ft. span and are located on the farther side of a railway crossing. A separate concreting plant on the west bank will furnish concrete for these two spans.

One mixing plant is used, and only one method of handling is employed—by bucket and crane. The plant is located on the island and is supplied with material by means of a high trestle, which extends from the bridge over the bins. There are two sand bins, two stone bins and two Hains mixers of ½-yd. capacity each. It has been found, however, that with the method adopted to move the concrete, only one mixer is required. The concrete for the arches is 1:2:4; that for the piers is 1:2½:5. The mixer discharges directly into 1-yd. Insley buckets (two on a car hauled by a gasoline locomotive). When both buckets have been filled, the dinkey moves forward off the siding and onto the trestle, proceeding to the point of concreting.

The concreting routine above springline is as follows: First, the umbrellas are poured, then the arch, then the arch spandrel wall, the pier spandrel wall, the arch coping and the pier coping. Concreting is carried on at only one point at a time.

Progress—the Outlook for Completion This Year

There are 45 umbrellas, arches and spandrel walls to be placed, and only 9 of these units had been finished on Aug. 17, at which time there remained but three months open to the contractor this season. On Aug. 17 there was 16,000 cu.yd. to be placed, and concreting was going forward at the rate of 5,000 cu.yd. per month. In the week commencing Aug. 7 there was placed 1,450 yd., while the total for August was 5,500 cu.yd. The rate of placing during the actual process of concreting is 1 yd., or 2½ batches, every 2 min.

Last season, with day and night shifts, 8,000 yd. of concrete was placed per month in September and October. Since Aug. 1 a night shift has been employed to erect forms.

By the middle of September several hundred feet of the new trestle (toward the west bank) had been erected. Although it was October before the east end of the present trestle could be dismantled and the 70-ft. I-beams released, there were enough spare beams to go ahead with

the new trestle. In September the railway forces began filling the east-channel arches with rough stone, preparatory to laying tracks.

The Robert Grace Contracting Co., Pittsburgh, is represented on the job by F. P. Kemon; for the Cumberland Valley R.R., Crosby Tappan, Engineer of Construction, is in charge under the general direction of Thomas B. Kennedy, Engineer.

American Society of Municipal Improvements Convention

The twenty-third annual convention of the American Society of Municipal Improvements, held at Newark, N. J., Oct. 10 to 13, will mark either the first step in its regeneration or prove a blow to its prestige which will be hard to recover from—all according to the use made of the experience by the new committee, under George W. Tillson, consulting engineer, of Brooklyn, N. Y., which will be appointed to revise the constitution and by-laws of the society. The passing of the motion made by Prof. Arthur H. Blanchard, of New York City, for the appointment of this committee may perhaps prove the most important business transacted by the convention.

The work of the convention was handicapped by an overloaded program, so that many papers were postponed from day to day, or omitted altogether. The three most important subjects considered were paving, sewage disposal, and garbage and refuse disposal. The proper presentation and adequate discussion of any one of these subjects would have taken all the time of the convention.

Pavements and Road Building

One of the most important subjects taken up was the necessity for limiting the loads, speed and size of vehicles. A paper with this title was read by E. W. Stern, chief engineer of the Bureau of Highways of the Borough of Manhattan, New York City. The damage done to West 42nd St., New York City, by 19-ton motor trucks, described in *Engineering News* of last week, formed the principal theme of this paper. The discussion brought out much information in regard to ordinances to prevent such damage, but it seemed that these laws are very difficult of enforcement. It was voted to have the matter referred to the Traffic Committee of the society for drafting a proposed law.

Other papers read were: "Business System Applied to Street and Road Management," by Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, Cleveland, Ohio; "Resurfacing Old Brick Pavements with Sheet Asphalt at Columbus, Ohio," by T. H. Branman, superintendent of asphalt; "The Proper Oil for Treating Creosoted Wood Blocks for Paving," by P. C. Reilly, Indianapolis, Ind.; "Concrete-Paving Experiences," by K. C. Gaynor, Sioux City, Iowa; "The Maintenance of Pavements," by C. D. Pollock, consulting engineer, New York City. George C. Warren, president of Warren Brothers Co., Boston, Mass., described, with moving pictures, the famous Columbia Highway in Oregon and also read a paper on the passing of macadam roads. There were many other papers read by title only.

The chief features of interest to paving engineers were the reports of the subcommittees on various kinds of pavements. That on sheet-asphalt pavements, Francis P. Smith, New York, chairman, reported the specifications adopted last year with only minor changes. An attempt was made on the floor of the convention to have this specification amended by adding thereto an entirely independent specification in which a distinction was made between the so-called natural asphalt and residual asphalt.

The present standard specification of the society is a "blanket" specification under which, it is held, any good paving asphalt may come in, although it is provided that the contractor must name the brand he intends to use. The proposed additional specification would have required separate bids on natural and residual asphalts. The attempt to have this adopted led to a long wrangle, which was ended only by a roll-call vote on whether or not it should be adopted against the advice of the subcommittee and of the chairman of the general committee on standard specifications. The proposed adoption was defeated by a vote of 33 yes to 59 no.

The subcommittee on wood-block pavement, E. R. Dutton, Minneapolis, Minn., chairman, reported a specification for creosote oil, which has been or will soon be accepted by five national engineering societies, including the American Society for Testing Materials. There was the usual opposition from material manufacturers, but the report was adopted. The specification is very nearly the same as that adopted at the convention in Dayton last year. A specification for water-gas tar as a preservative is included, but is not yet recommended by the subcommittee. Provision is also made for a bituminous cushion or bedding course, and for float and coke tests of the oil, which are new.

The subcommittee on bituminous paving, Linn White, Chicago, Ill., chairman, used its influence to have the bitulithic specification adopted by the Dayton convention last year omitted from the standard specifications for the ensuing year, but a motion to this effect was tabled, after a rather acrimonious discussion. In the main, the specification for asphaltic concrete pavement was little changed, except to make the clauses covering the asphaltic cement the same as those under sheet asphalt.

The subcommittee on brick pavements has eliminated the rattler test and has adopted a specification for a sand-cement bedding or cushion course, which is recommended "where proper sand cannot be obtained." No specification has yet been adopted for the so-called monolithic type of construction. The reports of the other subcommittees on paving contained little new or different from the specifications now in force.

Street Cleaning and Refuse Disposal

Under the subject of garbage and refuse disposal a paper read by Gustave R. Tuska, consulting engineer, New York City, on the reduction plant now building on Staten Island for the treatment of all New York City garbage, was of interest. Whether this plant will be completed and operated or not is a matter now before the state authorities; if built it will cost $3,000,000 and will be the largest and most up to date in the world.

Garbage collection and incineration in the small Philadelphia suburb of Sewickley, Penn., were described by Edward E. Duff, borough engineer. The principal feature of interest was the method of collection by transportation in the householders' cans, a duplicate can being left when the filled can was taken away. Other papers were read by title only.

"Street Cleaning in Savannah, Ga.," was the subject of a paper by E. R. Conant, chief engineer of the city. He stated that most published material on street cleaning was of little value because the local conditions were seldom given in sufficient detail. He has employed what he calls an efficiency timekeeper—a young technical graduate—who gathers and tabulates itemized cost data. "Flushing; Its Place in the Street-Cleaning Field" was the subject of a compendium by R. W. Parlin, of the Bureau of Municipal Research, New York City. A paper on "Some Public Health Aspects of Refuse Collection," by Charles Saville, Director of Public Health, of Dallas, Tex., was read.

What Happened to Activated-Sludge Symposium

The evils of an overloaded program and of permitting entertainment features to squeeze out real discussion were strikingly illustrated by the fate of the four papers on activated sludge. This is a subject of prime interest and importance. At great labor and with the coöperation of many engineers in various parts of the country, George T. Hammond, Brooklyn, N. Y., had collected descriptions of 11 activated-sludge plants, experimental and permanent, prefaced the description with a valuable historical review and ended his paper of 55 printed pages with a digest of conclusions. In addition, T. Chalkley Hatton had prepared a paper of 12 printed pages on his work at Milwaukee; Harrison P. Eddy, Boston, Mass., had written a paper describing experiments on sheepskin tannery wastes, and Gustav J. Requardt, Baltimore, Md., had summarized experiments made there with the activated-sludge process in one of the large Imhoff tanks. The four important papers named were scheduled with five others on sewage treatment for 2 p.m., Wednesday. The scheme was to read all the papers, then have a general discussion. The large attendance at this session showed the great interest in this group of papers.

What happened? First, of all, the session opened late—as usual at this and other conventions. Then two papers on subjects foreign to this session were presented. They aroused interest and suggested discussion, but the chairman announced that discussion must be postponed to the morning session. At 3 p.m. the four activated-sludge papers came on, supplying material enough for two full sessions. The chairman announced that the session must close at 4.30, so the meeting place could be transformed into a banquet hall, and that the discussion on these papers also would have to be continued at the morning session. This morning session, with four papers of its own and postponed discussion on six papers, it should be noted, was scheduled for 9 a.m., but at 10.30 the members and guests of the association were due at a railway station some blocks away to take an excursion train. The net result for the activated-sludge symposium was a hasty presentation of the four papers. This in itself did not so much matter, as all were printed in advance, but the authors and their auditors all felt the haste of the occasion. Discussion directly after the presentation of the papers was impossible. In fact, even their hurried presentation was interfered with by a start to begin moving banquet tables into the room. The hurry of the Thursday morning session gave no opportunity for satisfactory discussion. The net result was the loss of a splendid opportunity for a live, informing discussion of one of the most important subjects before municipal engineers today.

The whole incident was all the more disheartening because George T. Carpenter, Pawtucket, R. I., chairman of the Committee on Sewerage and Sanitation, had not only secured a valuable collection of papers on sewage treatment, but also, realizing that the papers could not be adequately discussed without advance printing, had succeeded in getting all but one of the papers in time to print in advance.

Other Municipal Subjects

A paper on "The Engineer and the Public: A Discussion of the Work of Bureaus of Municipal Research and State Leagues of Municipalities," by Edward T. Paxton, secretary of the Bureau of Municipal Research and Reference, University of Texas, led to a discussion of bureaus of municipal research in general and some criticisms of their work. It was said that their young employees were very free in destructive criticism of city public-works departments and that in most cases the fault lies with the city charter and laws under which the departments labored, rather than with inefficiency in the departments themselves.

"Water-Supply" was the subject of a committee report, J. W. Ackerman, chief engineer of the water-works of Auburn, N. Y., chairman, and a paper by Roger DeL. French, principal assistant engineer, R. S. and W. S. Lea, consulting engineers, Montreal, Que., discussed breaks in cast-iron pipe. The Newark water-supply was described by Morris R. Sherrerd, chief engineer of the Department of Public Works. "Recent Developments in Street-Lighting Theory and Practice," was the subject of a paper by P. S. Millar, general manager of Electrical Testing Laboratories, New York City. Many other papers were crowded out by the extraordinary length of the program.

Financial Condition—New Officers

The financial condition of the society is in a healthy state. The membership has largely increased—about 35% since the last convention. The attendance at the convention was nearly 400, and altogether the society appears in a flourishing condition.

The officers elected for the year 1917 are: President, Norman S. Sprague, Pittsburgh, Penn.; treasurer, F. J. Cellarius, Dayton, Ohio; secretary, Charles C. Brown, Indianapolis, Ind.; and chairman of the Committee on Convention Arrangements, George A. Carpenter, city engineer, Pawtucket, R. I. The place chosen for the next convention is New Orleans, La.

The City of Newark did much to make the convention an enjoyable one. The city tendered the members and guests a banquet on one evening, and the greater part of one day was devoted to an excursion to the new port of Newark and to a steamer trip around Manhattan. Another half-day was devoted to an automobile trip through the Essex County parks.

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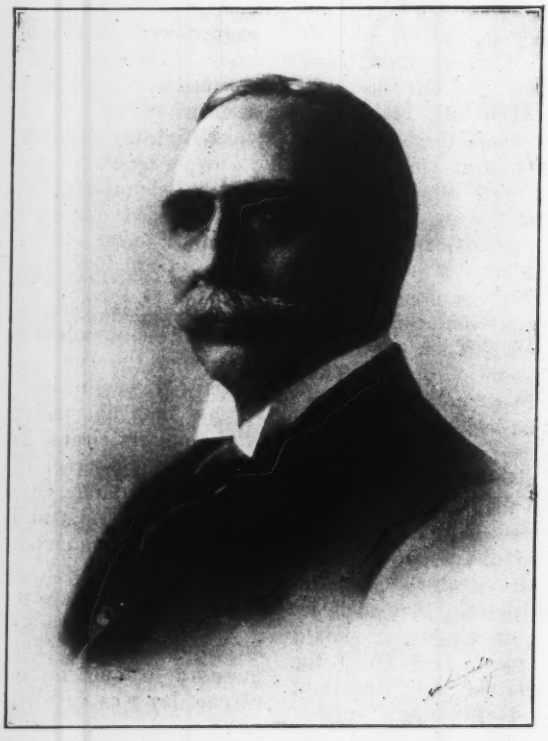
Injuries from Inhaling Exhaust Gases from gasoline locomotives used in mine drifts or tunnels are discussed in "Coal Age" of Sept. 30. A number of cases are cited where the poisonous effect from the exhaust gases discharged by gasoline locomotives in mines caused illness among the workmen and finally compelled the use of the machine to be discontinued. When a motor is working perfectly, securing complete combustion, the gas discharged is almost wholly CO_2 and has very little effect on health. A gasoline engine, however, due to improper adjustment or other causes, will often discharge unburned gasoline vapor in large quantities and its exhaust may contain at times carbonic oxide, the dangerous character of which is well known.

Virgil Gay Bogue

A wireless dispatch received in New York City, Oct. 15, recorded the death of Virgil G. Bogue, a civil engineer of international reputation, while en route from Mexico to New York on board the steamship "Esperanza." Mr. Bogue was in his 71st year, having been born at Norfolk, N. Y., July 20, 1846.

Mr. Bogue graduated from the Rensselaer Polytechnic Institute in 1868. His first professional work was as assistant engineer of Prospect Park, Brooklyn, N. Y. After a year there he resigned to become an assistant engineer of the Oroya Ry. in Peru, famous as reaching the highest altitude of any railway in the world. Later he was manager of the Trajille Ry. of Peru.

After two years in South America he returned to the United States to become assistant engineer of the Northern Pacific R.R. In locating this line across the Cascade Mountains in Washington he discovered and named Stampede Pass, through which the line is built. He remained with the Northern Pacific to supervise the construction of the road through Idaho and Washington until 1886, when he was appointed chief engineer of the Union Pacific R.R. After serving five years in this capacity Mr. Bogue resigned to take up private practice as a consulting engineer with offices in New York City. Since then he had been connected with many notable railway and transportation problems. He was a member of the commission appointed by President Harrison to investigate methods of improving the navigation of the Columbia River in Oregon. For three years he was consulting engineer to the Governor of New Zealand in connection with a proposed railway across South Island. Mr. Bogue was also prominently identified with New York City engineering problems. For a number of years he was consulting engineer of the Department of Public Works and was a member of the commission appointed by Mayor Strong to determine the feasibility of operating surface cars on Brooklyn Bridge. His other railway work after his retirement as chief engineer of the Union Pacific was important and country-wide. He made an examination and report on the cost of reproducing the lines of the Southern Pacific Ry. in Oregon; he prepared plans for water-front improvements at Seattle and Tacoma, Wash.; he made an examination and report on the cost of revisions and improvements of the Tehuantepec National Ry. of Mexico and of its port facilities. Another notable work was a report on the economics of the Denver, Western & Pacific Ry. He also made an investigation and report for the Canadian Pacific Ry. on the economics of the existing line from Calgary to Vancouver, B. C., as compared with a proposed revised line and other routes. He was consulted on many other intricate and comprehensive railway problems.



Virgil G. Bogue

With the beginning of one of the most recent transcontinental railways, the Western Pacific, Mr. Bogue again became an active railway officer. From 1905 to 1909 he was Vice-President and Chief Engineer of this company.

He was elected a member of the American Society of Civil Engineers in 1869. He served on the committee on standard rail sections, 1891-1893, and was a director of the society at the time of his death. He was also a member of the Western Society of Engineers, of the American Railway Engineering Association.

Mr. Bogue was married in 1872 to Miss Sybil Estelle Russell, of Canton, N. Y. He had three children.

Robert Swan

Robert Swan, Director of the Department of Public Works of Pittsburgh, Penn., died from heart disease, Oct. 14. Until the day before he had been regularly at his office and his sudden death came as a shock to his many friends and acquaintances. He was born in the City of Allegheny in 1859. His education was received at the public schools of the city and at the Western University of Pennsylvania (now the University of Pittsburgh), where he was graduated in engineering in 1877. In 1880 Mr. Swan became city engineer of Allegheny. In 1896 he joined the T. A. Gillespie Co., general contractors of New York City and Pittsburgh, becoming Vice-President and General Manager of the company. In his 17 years with this company he was connected with many of the most notable engineering projects of the day, including portions of the Catskill Aqueduct, the enlargement of the Erie Canal into the New York State Barge Canal and the Aspinwall water filtration plant of the City of Pittsburgh. In the fall of 1913 Mr. Swan was appointed by Mayor Armstrong of Pittsburgh to the office of Director of the Department of Public Works. An appreciation of his work here is best expressed in the Mayor's own words:

I place his engineering ability combined with his gift of common sense second to none in this country. He was not only great as a technical man, but he had the talent of being able to explain his plans and ideas in such a way as to make them understood by the humblest layman. In addition to this gift he knew how to handle men, get the greatest amount of work out of them and at the same time retain their loyalty and respect. He was big at heart as well as of brain, and he was actually loved by those who came in contact with him.

He is survived by a widow, a daughter and six sons.

News of the Engineering World

Iowa-Illinois Water-Works Men Hold Meeting

A joint meeting of the Iowa and Illinois sections of the American Water-Works Association was held Oct. 10 and 11 at Davenport, Iowa. About 50 members and guests were registered.

The majority of the papers dealt with the operating side of water-works service. Prof. J. H. Dunlap (University of Iowa), in a paper on sanitary drinking fountains, remarked that most of these are little better than the old-fashioned drinking cup. A paper on "Experience with Trenching Machines on the French and Russian War Fronts," was read by A. E. Miller, of Des Moines.

The second day of the meeting was devoted to a round of visits to the water-works and filter plants of the United States arsenal and the three cities of Davenport, Rock Island and Moline. The meeting closed with a dinner at Moline, at which an address was delivered by Leonard Metcalf, of Boston. His subject was the relation of public-service commissions and public-utility corporations.

The Iowa section held a business meeting, at which the following officers were elected: Chairman, C. R. Henderson, Superintendent of the Davenport Water Co.; secretary, Jack J. Hinman, Jr., University of Iowa, Iowa City, Iowa. The Illinois section will elect officers at its February meeting.

Two Turner Patents Defeated

Defeat of the Turner "mushroom" floor patents in a suit against the Lauter Piano Co. and the American Concrete Steel Co. was recorded by a decision of Judge Orr in the United States District Court at Trenton, N. J., on Oct. 11, 1916. The suit related to a building erected in Newark, N. J., and claimed infringement of both the Turner patents 1,003,384 (claims 1, 5, 10, 11, 16, 17) and 985,119 (claims 4 and 8). The decision declares all these claims invalid.

The narrow or specific patent, 985,119 was previously before the Circuit Court of Appeals of the Eighth Circuit, which declared claims 1, 4 and 6 invalid; Judge Orr adopts this decision. The broad patent, 1,003,384, was involved in Drum vs. Turner, also in the Eighth Circuit, and was there decided to infringe the Norcross patent, 698,542. Judge Orr adopts this view also and then declares that in consequence the Turner patent is anticipated and invalid. The substance of the decision follows:

Both patents relate to the reinforcement of concrete in the construction of buildings. The reinforcement of concrete is necesary, of course, to give the material the strength to resist the strains to which it may be put. It is not ordinarily reinforced to enable it to resist ordinary compression strains, because the vast remains of Roman civilization disclose an extensive use of concrete in construction where the effect of compression strains have been apparently negligible. Where, however, the horizontal section of the concrete mass is short and the vertical section is long and compression is vertical (as in a column), there must be reinforcement. Tensile strains and shearing strains, if they are differentiated, must be taken care of by reinforcing the concrete in the places where such strains are to be found. The character and location of such strains are determined empirically by many, but can be and more often are with reasonable accuracy determined by engineering methods. The ordinary material used in reinforcing concrete is iron or steel, because of its great tensile strength. It is used in the form of wire netting, in the form of bars and in other forms. Sometimes the reinforcing rods are unattached to each other and sometimes they are attached in order to preserve the framework of the reinforcing material until it may be embedded in the concrete. The rods are sometimes twisted, but often bent at proper angles, in proper places, in order that they may be better held in place by the compression of the concrete. We therefore have in this case patents, which upon their faces give monopolies in the use of ordinary materials for structural purposes, in the combination of such materials and in the engineering or mathematical problems relating to such construction. Where such conditions exist, the weight to be given to the patents as prima facie evidence of their validity is considerably weakened. If there could be a presumption that the Patent Office examiners had knowledge of what was going on throughout the country in the uses of ordinary materials for structural work, according to diversified, engineering opinion, the weight to be given to the patent should be as great as in the case of a machine or other form of mechanical apparatus.

It is unnecessary to refer to the specifications of the several patents at great length. It is significant that the patentee places emphasis upon the necessity of placing his reinforcement where the stresses are to be found. He states in one place that in warehouses and similar buildings the load is naturally concentrated around the columns; otherwise the aisles or passageways would be obstructed. That he therefore should have placed most of his reinforcing material around and connected with the columns which support the flooring is what any other thoughtful engineer might do.

From the foregoing observations it seems plain that neither of the patents is of a broad fundamental character. The claims of Patent No. 985,119, which are in suit, are as follows:

4. In flat-slab and column construction of concrete the combination of a concrete slab, concrete columns in vertical alignment above and below the slab, column reinforcement extending continuously through a vertical line of columns, cantilever heads separate from the column reinforcement, comprising, each, crossed rods embedded in the slab and extending laterally outward from the column in different directions, rods extending from said head downward into the column and groups of rods extending crosswise of the head through the slab from column to column in direct and diagonal lines, said rods being toward the bottom of the slab between columns.

8. In flat-slab and column construction of concrete the combination of a plurality of concrete columns and vertical reinforcements therein, of a separate and distinct set of reinforcing elements embedded in the column and principally supported thereby, the ends of said separate set of reinforcing elements being separated so as to radiate from the column into the floor slabs toward substantially all parts thereof, and a concrete floor slab embedding and supported by said radiating means.

This patent was the subject of litigation in the Eighth Circuit (211 Fed. Rep. 466). The Circuit Court of Appeals held that claims 1, 4 and 6 of the patent were invalid. The decision of that court was proper, notwithstanding the earnest efforts of counsel for the plaintiff in the present case to diminish the effect thereof.

Claim 8 of that patent which is now involved in the present litigation is not so different from claim 4 as to lead this court to think that it should be sustained.

We therefore conclude that the claims of Turner Patent No. 985,119, which are involved in this litigation, are invalid.

The claims of Turner Patent No. 1,003,384, which are involved, are as follows:

1. An arrangement of reinforcement for a column-supported flat plate floor of concrete, comprising a plurality of circumferential cantilever members, respectively situated in the upper part of the slab at the columns and projecting therefrom, and reinforcing means extending from member to member in multiple directions through the space between said members, and filling, or substantially filling such space.

5. An arrangement of reinforcement for a column-supported flat plate floor of concrete, comprising multiple belts

or rods that extend from column to column in two directions directly, and in two directions diagonally, portions of said belts being beyond the columns on opposite sides and forming cantilevers, the rods running in intersecting directions crossing at the columns in the upper part of the floor, and the cantilever-forming portions of rods of one belt supporting rods of another belt, the area between the columns being covered, or substantially covered, by reinforcements.

10. In a structure of reinforced concrete comprising columns, and a flat plate floor slab, the combination of an open frame consisting of crossed rods at the top of a column extending partially into the slab contiguous to the column and belts of rods extending crosswise of said open frame and passing through the slab directly and diagonally in straight lines from column to column.

11. The combination of concrete columns, and a flat plate floor slab of concrete supported directly thereon, horizontally arranged bars in the slab at the top of the columns, and supported thereby with their free ends extending outward into the slab from the columns forming cantilevers, and belts of reinforcement extending in multiple directions through the slab from support to support, and supported by said cantilevers.

16. The combination of concrete columns, and a flat plate floor slab of concrete supported directly thereon, horizontally arranged upon frames embedded in the concrete at the top of the columns extending transversely of the column axis, belts of reinforcement extending in multiple directions through the slab from column to column and supported by said frame, the belts being of a width to substantially cover the area between the columns.

17. In a reinforced-concrete structure, the combination of supports, consisting of columns of concrete, and a flat plate floor slab of concrete supported directly thereon, belts of reinforcement extending through the slab to the supports in four directions, said reinforcements having a thickness of four belts over the support in the upper part of the slab, a thickness of two belts in a diagonal direction midway between the supports in the bottom part of the slab, a thickness of one belt midway between the supports directly from one support to the other in the lower part of the slab and a set of reinforcements extending transversely of the column axis and projecting beyond the tops of the columns.

This patent has been the subject of litigation also in the Eighth Circuit (Drum vs. Turner, 219 Fed. Rep. 188). It is there held that a construction substantially after the manner pointed out in the specifications of Patents 985,119 and 1,003,384 issued to Claude A. P. Turner, Feb. 21, 1911, and Sept. 12, 1911, respectively, was an infringement of claims 1, 3 and 4 of Patent 698,542, issued to O. W. Norcross, Apr. 29, 1902.

This court is satisfied that the conclusions reached by the Court of Appeals in the Eighth Circuit in the case last cited should be adopted. Strenuous efforts on the part of the plaintiff to diminish the effect of that decision must fail. The Norcross patent is set up in the present case as an anticipation of the patents in suit. It seems clear that if a construction in accordance with the patents in suit would infringe the Norcross patent, that the Norcross patent must be an anticipation of the patents in suit. The effect of this decision is not weakened by the decision of the Court of Appeals of the First Circuit in the case of Turner vs. Quincy Market Cold Storage and Warehouse Co. (225 Fed. Rep. 41). That case principally decided that a tenant occupying under lease, a building, the construction of which embodies a patented feature, is not necessarily a "user" of the invention in such a sense as to be an infringer. Further consideration of the prior art either as found in structures, patents or publications offered in evidence on the part of the defendant would but unnecessarily lengthen this opinion.

The claims of both patents which are relied upon by the plaintiff in this suit are invalid. The bill must be dismissed at the cost of the plaintiff. Let a decree be drawn.

Street Cleaning Society Meets

The Society for Street Cleaning and Refuse Disposal of the United States and Canada held its second annual convention in New York City, Oct. 13 and 14. Although not yet very numerous in membership, the society has earned recognition in promoting technical knowledge of street cleaning and refuse disposal.

Papers were read on "Street Cleaning by the Wet System," by G. H. Hanna, former street-cleaning commissioner of Cleveland, Ohio; "Street-Car Flushers," by A. T. Rhodes, street commissioner of Worcester, Mass.; "Hand Sweeping," by Richard T. Fox, Chicago, Ill.; "The New York Anti-Litter League," by R. Ross Appleton, treasurer of the league; "The Horse in Street-Cleaning Work," by Dr. D. J. Mangan, New York City Department of Street Cleaning; "Accidents and Diseases," by Dr. S. I. Rainforth, New York City; "Control of Material and Supplies," by A. Schreiner, New York City; "Testing Apparatus," by John F. O'Toole, Pittsburgh, Penn.; and "Chicago's Problem," by A. W. Miller, Chicago, Ill.

The meetings were held in the convention hall of the Department of Street Cleaning Building at 140 West 20th St. A halfday was spent at the Department's school of instruction on the East Side, a new departure in street-cleaning work.

The present officers—John T. Fetherston, street-cleaning commissioner of New York City, President, and J. R. Buchanan, of the New York Street Cleaning Department, Secretary—were reëlected.

Slag Cement Is To Be Permitted in New Orleans paving work, following a recent order of the Council. The order states that specifications to govern the installing of subsurface drains, curbs, gutter bottoms, etc., and paving or repaving of streets with whatsoever kind of material, will be amended, so as "to permit the use of a new brand (commonly known as steel or slag) of cement" in the concrete foundations in all kinds of roadway pavement and in the brick masonry forming part of manholes, etc. It is expected that slag cement from Birmingham, Ala., will be used, as a company there has offered to sell in New Orleans its first-grade cement for 85c. per bbl. f.o.b. Birmingham.

Two Pavement Contracts at Bismarck, N. D., to the amount of nearly half a million dollars were recently let. A contract for 43,600 sq.yd. of bitulithic pavement was let to Hanlon & Okes, Minneapolis, Minn., for $114,872. The price was $2.38 per sq.yd. including a 5-in. concrete base. This is to be laid on the business streets and is to be completed by Nov. 1 of the present year. The other contract was for 149,400 sq.yd. of sheet asphalt at $331,568 and was let to the Ford Paving Co., Cedar Rapids, Iowa. The price was $1.90 per sq.yd., for a 5-in. concrete base, 1 in. of binder and a 1½-in. top. This is to be used on residence streets and is to be completed by Oct. 1, 1917.

New Steel Works for Norway—Two new companies for manufacturing steel plates for ships and other shipbuilding requirements have recently been formed in Norway, according to the United States consul at Christiania. One of these will have an initial output of 80,000 tons, including 30,000 tons of ship plates and 30,000 tons of rolled sections. The other company will produce 20,000 tons annually. Most of the materials for Norwegian shipbuilding were supplied by Germany before the war. There is an abundance of iron ore in the country, but the high prices of fuel for its smelting and working have previously discouraged the development of the steel industry, the ore for the past 10 years being exported.

Crushed Stone Is Dutiable according to a recent decision of the United States Board of General Appraisers in the test case filed by the Great Lakes Dredge and Dock Co., the MacArthur Brothers Co., and others, of Cleveland, Ohio. The Custom House authorities required 20% duty on the product under the section of the tariff laws specifying "earthy or mineral substances wholly or partially manufactured, and articles and wares composed wholly or in chief value of earthy or mineral substances, not especially provided for." The litigants claimed free entry under the specification "minerals, crude, or not advanced in value or condition by refining or grinding or other processes of manufacture, not especially provided for." Earlier custom decisions have granted free entry, but in 1906 the courts ruled against the custom authorities. The present test case was brought about in an attempt to upset these legal decisions.

To Arouse Interest in City Planning the Indiana Real Estate Association conducted a city-planning campaign from Oct. 9 to 18. The scheme was to visit every city having a real estate board and a number of other places besides, the visits to be made by various officers and members of the association. To have something specific and suggestive to lay before the real estate and other people of each city, the following addresses on city planning were made: "City Planning in Indiana," by Albert H. Schaaf, Fort Wayne, Ind., Chairman City Planning Commission, Indiana Real Estate Association; "The Civic Idea," by Richard B. Watrous, Secretary of the American Civic Association, Washington, D. C.; "The Essentials of City Planning in American Cities," by Flavel Shurtleff, Secretary, National Conference on City Planning, Boston, Mass. Lee J. Ninde, Fort Wayne, Ind., is president of the Indiana Real Estate Association, and Scott R. Brewer, Lemcke Building, Indianapolis, is secretary.

PERSONALS

C. R. Thomas, of Wilmington, N. C., has been appointed Division Engineer of the Kentucky State Highway Department.

J. L. Wilson, of the University of Michigan, has been appointed Professor of Electrical Engineering at Queens University, Kingston, Ont.

L. S. Eaton, of Cornell University, has been appointed Assistant Professor of Mechanical Engineering at Queens University, Kingston, Ont.

A. C. Norton, recently Chief Engineer of the R. Hardesty Manufacturing Co., Denver, Colo., is now President of the Norton Engineering and Contracting Co., 2046 Vine St., Denver.

A. M. Mutersbaugh, formerly Engineer of the Highway Department of Calcasieu Parish, Lake Charles, La., has been appointed Engineer of the Sewerage Board of St. Charles, succeeding J. E. McCorkle.

James C. Travilla, former Street Commissioner of St. Louis, Mo., has been appointed Receiver for G. A. Heman, General Contractor, of St. Louis, against whom involuntary bankruptcy proceedings were recently filed in the Federal District Court.

Stuart S. Neff, recently Construction Engineer of the engineering department of the Baldwin Locomotive Works, Philadelphia, Penn., is now Engineer of Construction of the Ferrocarril de Samaná y Santiago in the Republic of San Domingo, W. I.

H. G. Sparks, recently Division Engineer of the Chicago & Eastern Illinois R.R., at Salem, Ill., has been promoted to be Assistant Superintendent of the Chicago division of the railway. He is succeeded as Division Engineer by A. W. White, formerly Office Engineer at Chicago.

Alfred J. Stevens, M. Can. Soc. C. E., recently in charge of the Manitoba district of the Department of Public Works of Canada, has been transferred to Windsor, Ont., relieving Col. H. J. Lamb, M. Can. Soc. C. E., who is with the Overseas' Forces of the British Army in France.

Prof. E. Mörsch has been called to the Stuttgart Technical College as Professor of Structural Engineering. He leaves the firm of Wayss & Freytag, Neustadt a.d. H., with whom he has been associated for a number of years. Dr. Mörsch was Professor of Statics and Bridges at Zürich from 1904 to 1908.

A. H. Jewell, formerly employed at the filtration plant of the Toledo, Ohio, city water-works, has been appointed Assistant Engineer of the Kansas State Board of Health, with headquarters at the State University at Lawrence, Kan. He is a graduate of the Michigan State Agricultural College and of the University of Michigan.

Robert F. Olds, Assoc. M. Am. Soc. C. E., formerly Consulting Engineer at El Paso, Tex., has been appointed General Superintendent of Construction of the Philadelphia district of the Samuel Austin Co., of Cleveland, Ohio. Mr. Olds graduated from the University of Maine in 1906 and has had a variety of experience in different parts of the country.

James R. Elliott, M. Am. Soc. C. E., has become associated with George S. Baton & Co., Civil and Mining Engineers, Pittsburgh, Penn., which will hereafter be known as Baton & Elliott, Civil, Mining and Consulting Engineers, Pittsburgh. Mr. Elliott returns to Pittsburgh after an absence of ten years in California, Arizona and Utah. The new firm will specialize in reports and development of mining properties.

OBITUARY

William H. Newley, a public works contractor, of Indianapolis, Ind., died Oct. 6 as the result of a collision between a trolley car and the automobile in which he was riding.

William J. Bradley, President of the American Dredging Co., of Camden, N. J., died Oct. 13 at the hospital of the University of Pennsylvania. He was prominent in New Jersey politics and was twice president of the State Senate.

E. M. Buts, an architect and civil engineer, of Pittsburgh, Penn., died Oct. 4 at his home in that city. He was one of the promoters and the designer of the Columbia Iron and Steel Co.'s plant at Uniontown, Penn., of which he was for a time General Manager.

Ralph Tolles Norton, a prominent railroad contractor, died at Audubon Sanitarium, New York City, Monday, Oct. 9, following an operation. He had been associated with the Carter Construction Co., F. M. Ferguson Contracting Co., Degnon Contracting Co., and at the time of his death he was a member of the firm of Norton, Head & Denneen, which firm had a few months since completed the contract for the construction of the Mill Creek Joint District Sewer in St. Louis, Mo. Mr. Norton was a member of the Engineers Club and the Railway Club in New York City and of the City Club of St. Louis. He leaves a widow and four children.

Leonard W. Rundlett, M. Am. Soc. C. E., for many years City Engineer of St. Paul, Minn., and for two years Commissioner of Public Works of Moose Jaw, Sask., Canada, died Oct. 15 at his home in St. Paul. He was one of the best-known municipal engineers of the Northwest and had a large circle of friends and acquaintances. He was born in Brunswick, Maine, in 1846. He went to St. Paul when he was 25 years of age and for three years was employed by the St. Paul & Pacific Ry. After that he became connected with the city engineering department as an assistant to the City Engineer. Subsequently he became City Engineer and served almost continuously in that office until 1911, when he left to become Commissioner of Public Works of Moose Jaw. His service as Engineer of the St. Paul water department covered 27 years. After two years at Moose Jaw he returned to St. Paul, where he maintained an office for private practice until taken ill last June. He is survived by a widow and one daughter.

Prof. Levi L. Conant, head of the department of mathematics of the Worcester Polytechnic Institute, Worcester, Mass., was killed Oct. 11 by an automobile truck, which ran over him while he was hurrying to take a car from his home to the Institute. He was born in Littleton, Mass., Mar. 3, 1857. He took his A.B. degree at Dartmouth in 1879 and the A.M. degree there in 1887, being awarded also the degree of Ph.D. by Syracuse in 1893. He was Professor of Mathematics in the Dakota School of Mines, 1887-90, and became Professor of Mathematics at the Worcester Polytechnic Institute in 1891. He was Acting President there, 1911-13. He was a member of the Worcester School Committee many years and its chairman in 1909. He was a member of the Massachusetts State Board of Education, 1909-14. He was a Fellow of the American Academy of Arts and Sciences, a member of the American Mathematical Society and of the London Mathematical Society. He was author of "The Number Development," "Original Exercises in Plane and Solid Geometry" and "Plane and Solid Trigonometric Tables." He was editor of the "Journal" of Worcester Polytechnic and a contributor to many educational and scientific journals.

ENGINEERING SOCIETIES

AMERICAN PUBLIC HEALTH ASSOCIATION.
Oct. 24-27. Annual convention at Cincinnati, Ohio. Secy., Prof. Selskar M. Gunn, Boston, Mass.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.
Oct. 30-Nov. 4. Annual meeting at La Salle Hotel, Chicago. Secy., J. A. Andreucetti, C. J. N. W. Ry., Chicago.

AMERICAN MINING CONGRESS.
Nov. 13. In Chicago, Secy., J. F. Callbreath, Munsey Bldg., Washington, D. C.

AERO CLUB OF AMERICA.
Nov. 13. Annual meeting in New York City. Secy., Wm. Hawley, 297 Madison Ave., New York City.

NATIONAL COMMERCIAL GAS ASSOCIATION.
Nov. 13-18. Convention in Atlantic City, N. J. Secy., Louis Stotz, 61 Broadway, New York City.

RICHMOND RAILROAD CLUB.
Nov. 13. Annual meeting. Secy., F. O. Robinson.

NATIONAL ASSOCIATION OF RAILWAY COMMISSIONERS.
Nov. 14. Convention in Washington, D. C. Secy., W. H. Connolly, Washington.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 16-17. Annual meeting in New York City. Secy., D. H. Cox, 29 W. 39th St.

ELECTRIC POWER CLUB.
Nov. 15-17. Annual meeting in Hot Springs, Va. Secy., C. H. Roth, 1410 W. Adams St., Chicago.

KANSAS GOOD ROADS ASSOCIATION.
Nov. 16-17. Annual meeting in Lawrence Society headquarters in Kansas City.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 16. Annual meeting in Atlanta, Ga. Secy., A. J. Merrill, P. O. Box 1205, Atlanta.

CITY MANAGERS' ASSOCIATION.
Nov. 21-23. Convention in Springfield, Mass. O. E. Carr, Niagara Falls, N. Y.

NATIONAL MUNICIPAL LEAGUE.
Nov. 23-25. Annual meeting in Springfield, Mass. Secy., C. R. Woodruff, 705 North American Building, Philadelphia.

RAILWAY GARDENING ASSOCIATION.
Dec. 5-7. Annual meeting in New Orleans. Secy., Charles E. Lowe, Sewickley, Penn.

PORTLAND CEMENT ASSOCIATION.
Dec. 11-13. Annual meeting in New York City. Assistant to General Manager, A. H. Ogle, Chicago, Ill.

The Central States Division of the American Water-Works Association held its 20th annual meeting last week at Cleveland.

The American Road Builders' Association will hold its annual meeting on Nov. 3 at the Automobile Club of America, 247 West 54th St., New York City. In the evening a dinner will be held in the grillroom. The secretary is E. L. Powers, 150 Nassau St., New York City.

The American Association of Engineers held a dinner at Chicago on Oct. 6, at which there was an attendance of 1,200. The meeting was called to order by E. V. Hill, chairman of the Chicago Chapter, who turned the chair over to A. H. Krom, chairman of the national membership committee. The principal address was by C. F. Harding, professor of electrical engineering, Purdue University, on "Marketing Engineering Ability." John Erickson, who has held his position as city engineer through numerous changes of political administrations, discussed that portion of Professor Harding's address which referred to tact. Others who took part in the discussion were Dabney H. Maury, L. K. Sherman, W. H. Roscrans and H. B. Wild. Arthur Kneisel, national secretary, talked on ethics for engineers and explained how the association was working on this problem.

Appliances and Materials

New Railway Track Switch

A new railway switch that is being tried experimentally is of the stub-rail type, but with features intended to avoid the objections that have made the old style of stub switch obsolete.

Each side of the switch consists of a pair of rails bolted together, with fillers between them, and pivoted at the toe to a base plate that extends the full length of the switch and carries the ends of the fixed rails. In this way the variation in width of the open joint, owing to expansion and contraction, is minimized, and creeping of the switch rails is prevented.

The two sides of the switch are connected by tie-rods, or in this case plates, in the usual way, and the operating rod is attached to one of the base plates. This rod is connected to a crankshaft, which may be operated by hand mechanism or automatically by an electric motor.

As a precaution against derailments, should a train trail through an open switch, a device similar to those of the old Tyler and Cooke stub switches, has been added. In the illustration, for example, a train coming from the main track into the switch, as shown, which is set for the siding, one wheel flange is held against the inside gage line by the guard rails, while the flange of the opposite wheel is led into a groove on the outside of the main-line rail, mounts an incline to the level of the head of the rail and drops into its place on the gage line.

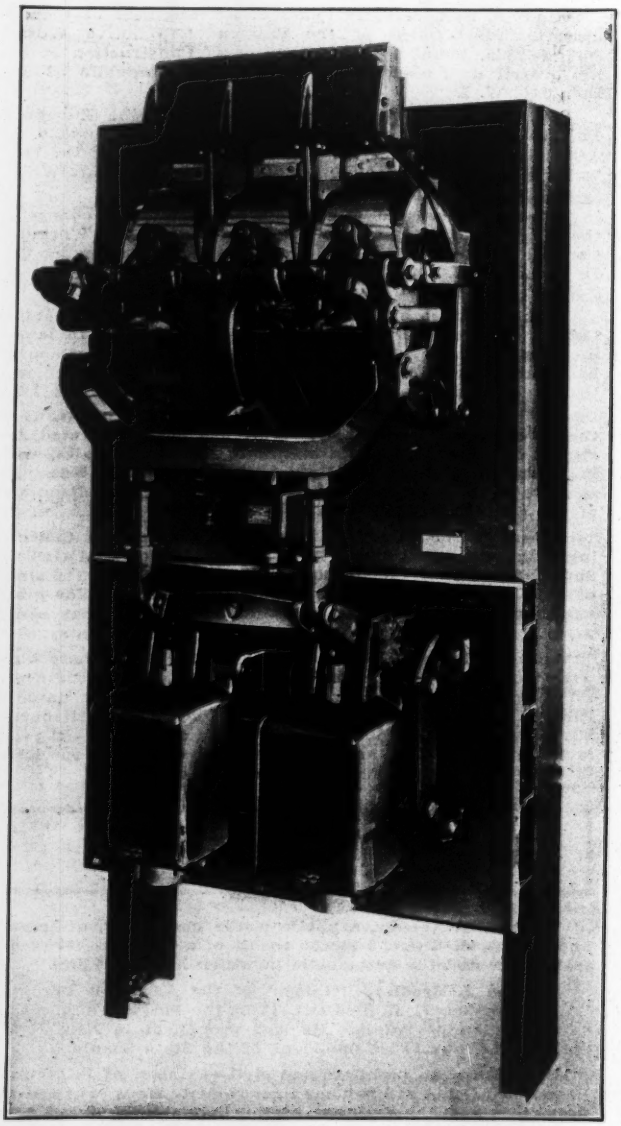
The new switch is the invention of Ira A. Call, of Denver, Colo. The experimental installation shown is on the Brooklyn Rapid Transit Co.'s electric line near Brighton Beach (New York).

AUTOMATICALLY OPERATED TRACK SWITCH

* * *

A 20,000-Ampere Direct-Current Circuit-Breaker

Probably the largest circuit-breaker is one of the solenoid-operated type recently developed by the General Electric Co. for controlling direct-current circuits of unusually high capacity. The normal continuous rating is 20,000 amperes. This circuit-breaker is one of four of the same capacity built for the Aluminum Co. of America for installation at Massena, N. Y. The closing and opening movements under normal conditions are controlled by a single-pole double-throw control switch mounted remote from the breaker on the switchboard or in some other convenient location. On overload or short-circuit the breaker opens automatically by means of a direct-acting trip. The breaker is mounted on a 2½-in. slate panel. The solenoid mechanism is supported by a steel base.



LARGE DIRECT-CURRENT CIRCUIT-BREAKER